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Inventory of Fishers in the Sub-boreal Forests of North-Central British Columbia Phase 1: Capture and Marking

R. D. Weir
1997

PWFWCP Report No. 130

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Abstract

A live-trapping program was initiated during autumn 1996 to capture and mark fishers in the Manson River - Mesilinka River areas to the west of Williston Reservoir. This was the first phase of a 5 year project examining the ecology of fishers in sub-boreal landscapes. The objectives of the first phase were to radio-collar and ear-tag fishers for future identification and monitoring.

Four different trap designs were used to capture fishers: Havahart wire-mesh cage traps (collapsible and permanent), log-cabin traps, and barrel traps. Traps were operational for 3,095 trap nights at 81 sets in 2 general areas from 19 October to 17 March 1997. We were able to immobilise and radio-collar 8 of the 11 fishers that we captured at 11 different traps (4 Havahart, 7 log-cabin) throughout the study area. Two additional fishers were captured and radio-collared outside of the study area. We recorded an overall capture rate of 0.58 fishers per 100 trap nights. Traps malfunctioned 272 times at 58 sites.

Several factors may have influenced capture success. Capture success was likely most heavily affected by population density, suitability of habitat, fisher behaviour, and access restrictions. Temperature and trapping effort did not appear to regulate the capture rate that we observed, although these factors may have limited the likelihood of capture.

Radio-collared fishers were located 84 times during aerial telemetry flights. Fishers were also located on 5 occasions using ground telemetry. We recorded fishers using hybrid spruce - black cottonwood dominated riparian forests most frequently. Four natal dens were identified, all in large diameter, declining black cottonwood trees in riparian or riparian-associated habitats.

We encountered several difficulties with the reliability of the equipment used to mark fishers. Only one of four recaptured fishers had both eartags intact. Eartags did not provide a permanent method of marking individuals and resulted in injury to the fishers because the tags ripped out of their ears. Because of problems with the design of the transmitter, signals from radio-collars were often not detectable from greater than 1 km away during aerial monitoring and 500 m during ground monitoring. This design flaw may bias sampling during ground telemetry. A new design, with a larger, more robust transmitter and antenna, may alleviate this problem.

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1.0 INTRODUCTION

The fisher *(Martes pennanti)* is a medium-sized member of the Mustelidae (weasel) family that inhabits much of the lowland forested area that dominates the plateau of north-central British Columbia. Fishers are considered to be habitat specialists, fulfilling most of their life requirements in forested habitats (Powell 1982, Weir 1995). Evidence from studies of fishers in western coniferous forests indicates that fishers require late-successional seral stages or elements for foraging, resting, and whelping (Jones 1991, Weir 1995). Because of this strong association with late-successional forests, harvesting activities that focus on late-successional forests can have detrimental effects on fisher populations by altering and degrading the abundance and distribution of the resources that they require.

Fishers are classified as furbearers under the British Columbia Wildlife Act and are trapped for their pelts. Fishers are on the Conservation Data Centre's provincial blue-list, indicating that the status of their populations is "vulnerable". Fishers are also classified by the Wildlife Branch of the Ministry of Environment, Lands and Parks as Class 2 furbearers because they are susceptible to overharvest, their populations occur at low densities, and home ranges of individual fishers can span more than one trapline. Although fisher pelts are valuable relative to other furbearing mammals, the majority of the harvest of fishers in British Columbia is the result of incidental captures in traps set for marten *(Martes americana)*.

Fishers, along with many other carnivores, are difficult to census. Because fishers are solitary and have large, intrasexually exclusive home ranges, they occur at low densities. These factors, in conjunction with their secretive behaviour, low catchability, and susceptibility to displacement by human activities, make detection of fishers for inventory purposes difficult.

The objectives of the first phase of this inventory project were to capture, mark, and monitor movements and habitat use of fishers in a representative forest landscape of sub-boreal forests in north-central British Columbia.

Funding for this project was provided by the Operational Inventory Program Portfolio of Forest Renewal British Columbia (Project # OP96-220) and the Peace/Williston Fish and Wildlife Compensation Program, a joint venture between BC Hydro and the BC Ministry of Environment. Partners in this inventory program were the Peace/Williston Fish and Wildlife Compensation Program, the British Columbia Ministry of Environment, Lands and Parks, Finlay Forest Industries Ltd., TimberWest Ltd., and the British Columbia Trapper's Association. The project was conducted co-operatively with the Northern Wolverine Study (Forest Renewal British Columbia Project* OP97-078), whose personnel assisted in the collection of much of the data. F. Corbould administered project funds and assisted in the field. A. Bowser helped monitor traps, radio-collar fishers and wolverines, and perform radiotelemetry.

2.0 STUDY AREA

The study area covers approximately 2160 km^2 and is centred 70 km north-west of Mackenzie, British Columbia (Fig. 1). The entire area is within the Peace River drainage. All watersheds within the study area drain into the Williston Reservoir. The major watersheds in which the inventory is occurring are the Manson, Omineca, and Mesilinka Rivers. The study area is bounded by Williston Reservoir to the east, Nation River to the south, the Wolverine and Swannell Ranges to the west, and the bend in the Mesilinka River (south of Carina Lake) and Mica Creek to the north.

The study area lies within the Sub-Boreal Interior ecoprovince, Omineca Mountains ecoregion, and Parsnip Trench, Southern Omineca Mountains, and Manson Plateau ecosections (Demarchi 1995). The boundary of the study area is defined by the extent of the Sub-Boreal Spruce (SBS) biogeoclimatic zone that occurs in this region. The topography of the study area is characterised by a gently rolling plateau rising from the Rocky Mountain Trench (Williston Reservoir) in the east to the slopes of the Wolverine and Swannell Ranges in the west. The plateau is drained by a series of small creeks with poorly developed or non-existent floodplains. Floodplains with extensive riparian zones exist on only three major rivers: the Manson, Omineca, and Mesilinka Rivers.

The study area is comprised of two subzones of the SBS. At elevations below 800 m, the moist cool subzone (SBSmk) of the SBS occurs, while between 800 and 1100 m, the wet cool subzone (SBSwk) occurs (B.C. Ministry of Forests 1993). The SBSmk comprises the majority of the study area, covering approximately 80% of the area. Annual precipitation in the SBSmk is 690 mm and 905 mm in the SBSwk (B.C. Ministry of Forests 1993). Snowfall in the SBSmk is 335 cm/year and 1075 cm/year in the SBSwk (B.C. Ministry of Forests 1993). Snow cover in the study area lasts from November until April.

Forests in the SBSmk are dominated by hybrid spruce *(Picea glauca* x *engelmannii},* lodgepole pine *(Pinus contorta),* black spruce *(Picea mariana],* and subalpine fir *(Abies lasiocarpa),* with deciduous components of trembling aspen *(Populus tremuloides)* and paper birch *(Betula papyrifera).* Black cottonwoods *(Populus balsamifera* spp. *trichocarpa)* occur as a minor element in riparian-type ecosystems and occasionally in other areas with sub-hygric or wetter ecological moisture regimes. The composition of forests in the SBSwk is similar, with hybrid spruce and subalpine fir being more dominant.

Disturbances in the SBSmk and SBSwk follow a typical pattern. The primary disturbance factors in these ecosystems are fire and insect outbreaks (B.C. Ministry of Forests 1993). Young forest stages are comprised primarily of lodgepole pine, while later successional stands are dominated by spruce and subalpine fir. The SBSmk has a natural disturbance regime of frequent, large-scale burns occurring about every 125 years, while the ecosystems in the SBSwk portion of the study area are exposed to moderate-sized burns with a fire cycle of about 200 years (B.C. Ministry of Forests and B.C. Ministry of Environment, Lands and Parks 1995). With the flooding of the Williston Reservoir in 1968-70, much of the valley bottom riparian forests in the area were submerged, mostly in the lower Omineca, Manson, and Parsnip Rivers. Forest harvesting, primarily of

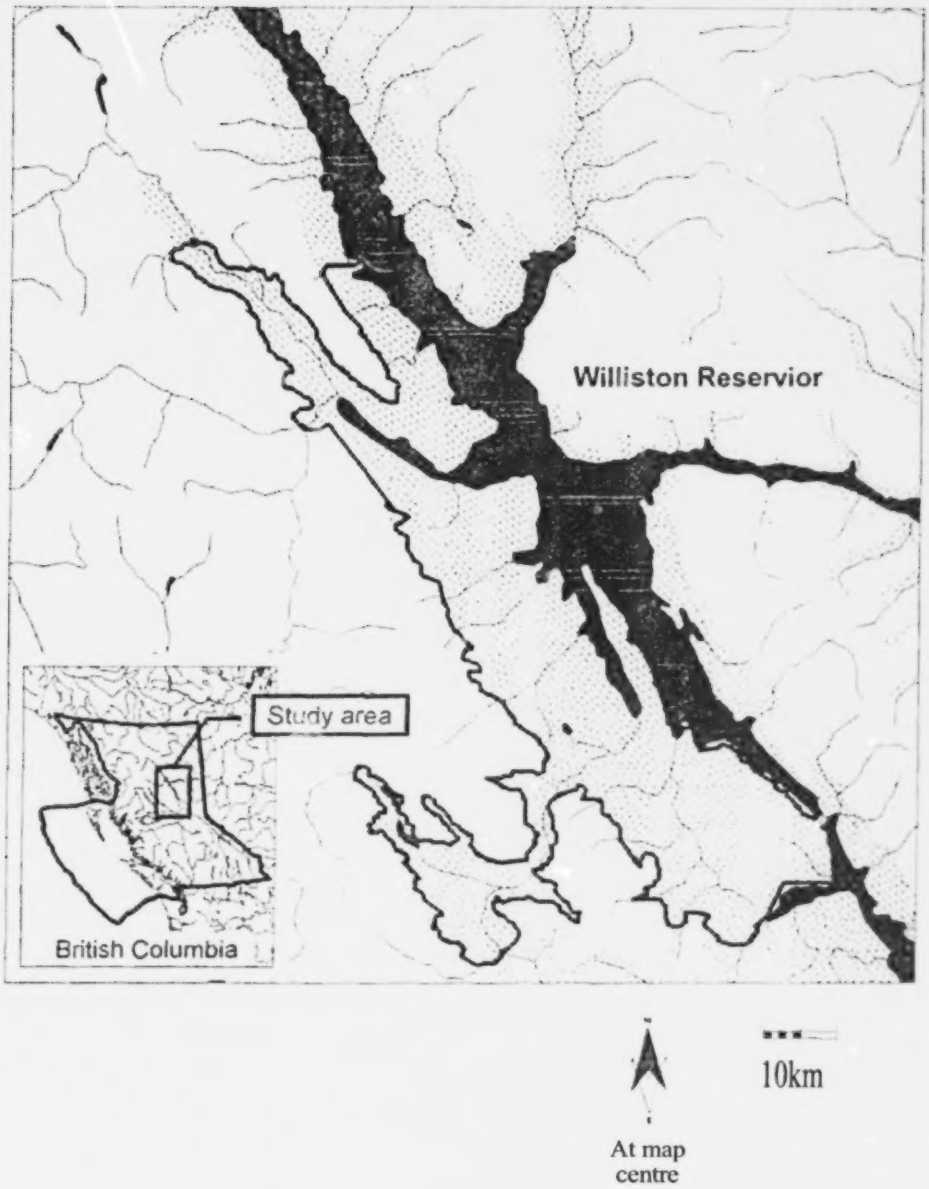


Figure 1. Location of the study area and biogeoclimatic subzones. The study area is comprised entirely of the SBSmk and SBSwk subzones (cross-hatched area). The solid line is the study area boundary.

mature and late-successional stands, has occurred throughout the study area over the past 25 years. Forest harvesting and natural disturbances have resulted in a mosaic of seral stages and stand types throughout the study area.

The study area encompasses five registered traplines. Traplines in the northern portion of the study area include 738T009, which is located primarily on the Mesilinka River, and 738T010, which occupies the Chunamon Creek/Raspberry Harbour area. Trapline 729T005 runs from km 149 on the Finlay Forest Service Road (FSR) south beyond the Manson River. Trapline 728T007 occurs on the Manson River drainage west of the Wolverine Range and 729T004 occupies the Blackwater Creek area.

3.0 METHODS

3.1 Trap site reconnaissance and selection

We assessed habitats for suitability for fishers (thus trap locations) throughout the study area on the basis of several habitat variables identified as important in previous studies of fisher ecology (Jones 1991, Weir 1995). Structural stage was the primary variable that was used to identify potential fisher habitat. Later-successional stands, with high structural complexity of the forest floor and dominated by hybrid spruce, were selected because these habitats provide potential resting cover and foraging habitat. Stands with riparian influence (i.e., sub-hygric and wetter moisture regimes) were also identified as potential trap site locations because the structural complexity associated with these areas makes them suitable for foraging and resting. Stands with well-developed components of large, declining black cottonwoods were also selected for trap sites because these areas may provide den trees for resting and whelping.

We identified potential trap locations from both aerial and ground reconnaissance of the study area. From aerial reconnaissance, we were able to assess the landscape position of suitable stands, as well as determine the degree of access to appropriate areas. The key factors that were used during aerial reconnaissance to assess habitat suitability were composition of the overstorey, estimated structural stage, proximity to wetlands/riparian zones, and continuity with late-successional stands. Ground reconnaissance was performed from a 4x4 vehicle during October or on snowmobile during November to March. From ground-based surveys, we were much better able to assess structural complexity but were limited to areas to which we could drive or snowmobile.

3.2 Trap types

We monitored four types of live-trap sets: barrel, log-cabin, Havahart collapsible, and Havahart permanent. The Havahart styles were intended solely for fishers. Because capture work for wolverines *(Gulo gulo)* was conducted concurrently within the same study area, we used barrel and log-cabin traps to capture both fishers and wolverines.

The majority of the fisher traps that we set were Havahart collapsible traps (Model 1089). These wire-mesh sets were approximately 24.5 x 31 x 81 cm and

collapsed by the back door folding out and the sides of the trap folding inward. When the trap was operational, the sides and rear doors were held in place by rods snapped into holding brackets. Havahart permanent traps (Model 1081) were similar in dimensions to the collapsible type, but the sides and rear doors were permanently wired together. Both these trap types were very portable, we were able to opportunistically place traps in areas that appeared to be suitable habitat for fishers or where we observed fisher tracks.

We also monitored and set several log-cabin and barrel traps that were intended primarily for wolverines. The log-cabin sets were made of intermeshing logs, with a trigger mechanism that released a log door when a bait was pulled from inside the trap (Krebs 1993). Barrel traps consisted of a 45 gallon drum with a sliding door cut into one end (Banci 1987), similar in design to culvert traps used to capture bears. Log-cabin traps were permanent, while barrel traps could be moved to a preferred trap site, but with much more difficulty than Havahart traps.

3.3 Trap setting, monitoring, and data analysis

We set Havahart traps in patches of habitat that appeared to fulfil the habitat requirements listed above or otherwise appeared to be used by fishers. We selected trap locations within these patches that had microsite attributes, such as coarse woody debris (CWD) or clusters of trees, that have been reported to be used by fishers (Weir 1995). Traps were often set under or beside elevated pieces of CWD or in the middle of groups of trees.

Each Havahart trap was set to ensure that trapped animals remained dry, insulated, and had a supply of food. We placed traps on beds of hybrid spruce or subalpine fir boughs and covered the top and sides of the traps with either sheets of plastic or disassembled cardboard boxes (trap packaging). Traps were lined with hay and covered with more boughs so that snow or wind would not penetrate the trap. Log-cabin and barrel traps did not require special insulation techniques. We baited each Havahart trap with approximately 500 g of salmon. Log-cabin and barrel traps were baited with whole salmon (1 - 4 kg) or pieces of moose carcass (1.5 - 3 kg).

We took several actions that were intended to enhance the efficacy of the traps. At each trap location, several nearby trees were scented with a combination of commercial fisher, marten, and skunk lure. Scent was re-applied every 5 - 7 days. Prior to setting the trap for the first time, the pan, cable, and door of each trap was tested to ensure proper trap performance.

We checked traps daily and assessed the functioning of each trap every 2-3 days. The status of each trap was recorded for each night (i.e., one trap night) from one of the following descriptive categories: species captured, empty, blocked, tripped, or escape. "Empty" was recorded for those trap nights during which trap function was normal but no animals were caught. "Blocked" was recorded for trap nights during which the trigger, pan, or door did not function properly. "Tripped" traps occurred when the trigger, pan, or door functioned properly but the animal was not captured. Tripped traps were often caused when either ermine *(Mustela erminea)* tripped the pan and escaped through the side of

the trap. "Escapes" occurred when animals tripped the trap, but managed to break out of the trap.

Because of the different design of the log-cabin and barrel traps, one additional category of trap status was used to describe the wolverine traps that we checked. The trigger mechanism on these traps was not as sensitive as on the Havahart traps, so marten would often not trigger these wolverine traps, even though they may have consumed the bait. Consequently, the wolverine trap was then unable to capture other animals and needed to have bait retied to the trigger mechanism, a category that we called "rebait". For analysis, we considered rebaited traps to be "blocked".

When non-target species were captured in the traps, animals were released immediately. We closed and removed traps at locations where martens were captured on more than 5 consecutive nights.

The time and duration for which the trap was operational was recorded while checking the traps. We calculated the total hours that each trap was operational based upon the number of hours that the trap was open and empty. For trap nights during which an animal was caught or the trap malfunctioned, we assumed that the capture or malfunction occurred immediately after the trap was last checked. This method of trap assessment resulted in a conservative estimate of total hours operational.

To maximise the number of traps that could we could have operational, Havahart, log-cabin, and barrel traps were monitored by both the Fisher Project and Wolverine Project personnel. Complete information was not always collected for every trap because of the different procedures used by either crew when checking traps.

Maximum and minimum temperatures were recorded on a daily basis at various locations throughout the study area. Temperature stations were located at 4 trap sites: Finlay 148, Finlay 171, Mesilinka Camp, and Chunamon 43. Thermometers were placed in the forest interior, at least 20 m from the forest edge.

We calculated various measures of capture rates for different species and trap types. We calculated the number of captures per 100 trap nights for fishers, wolverines, and non-target species. We tested for the effect of mean monthly temperature on monthly capture rates of fishers using linear regression. We also performed chi-square goodness-of-fit tests with Bonferroni-adjusted Z-tests to determine if any types of traps were more effective at capturing fishers than others. We also used chi-square tests with Bonferroni-adjusted Z-tests to examine the frequency of malfunctions among the different trap types. Chi-square goodness-of-fit tests were also used to compare the frequency of capture of fishers in 4 temperature ranges (< -20 C, -20 C to -10 C, -10 to 0 C, and 0 C to 10 C) to expected, based upon temperatures that were recorded during each day of trapping. We set the acceptable Type I error rate to 0.05.

3.4 Immobilisation and handling procedures

Prior to immobilisation, we estimated the body weight of each fisher to ensure that animals were administered controlled dosages of anaesthetic. To immobilise fishers captured in Havahart traps, we used a handling cone to restrain the animal and administered drugs with a hand-held syringe. Fishers in log cabin traps were injected using a jab-stick.

Fishers were immobilised using either a 10:1 mixture of ketamine:xylazine (Ketaset/Rompun) or a 1:1 mixture of tiletamine:zolazepam (Telazol). We attempted to administer Ketaset/Rompun at 20 mg/kg and Telazol at 12 - 18 mg/kg.

We monitored and measured fishers while they were immobilised (Appendix 1). Sex, body weight and cranial and skeletal measurements were documented. Each fisher was fitted with a radiocollar, assigned individual identification numbers, and ear-tagged with individual colour combinations of eartags. We collected hair samples and attempted to collect blood samples from each fisher. We removed a premolar 1 tooth from healthy fishers for cementum annuli analysis (Strickland et al. 1982). We classed fishers that had worn teeth or lingual erosions as adults or juvenile by palpating the saggital crest and examining the level of tooth wear (Powell 1982). Each animal was also tattooed with its respective identification number in its inguinal area. Photographs were taken of the head and ventral region. Respiration and cardiac rate, body temperature, and capillary refill time were also recorded at regular intervals while the fishers were immobilised. We used t-tests to examine differences in morphological measurements between male and female fishers.

Fishers were placed back in the live trap to recover from the drugs following immobilisation. We wrapped each fisher in a blanket to reduce the likelihood of hypothermia. We released the fishers from their cages when they were fully recovered from the effects of the anaesthetic.

3.5 Radiotelemetry monitoring

We located fishers using standard ground and aerial telemetry procedures (Weir 1995). We located fishers from the air using Cessna 182 aircraft with two bi-directional H-antennae mounted on the wing struts (Appendix 2). From the ground, we recorded directional bearings of fishers using a three-element, collapsible Yagi antennae at permanent ground stations.

We located fishers once per week from the air and whenever possible from the ground. Coordinates from aerial locations were estimated using either a global positioning system (GPS) or from 1:20,000 forest cover maps. Coordinates were collected as latitude and longitude with the GPS and as Universal Transverse Mercator (UTM) coordinates from the forest cover maps. GPS coordinates were converted into UTM coordinates for analyses using UTM conversion software (Geological Survey of Canada 1988). All ground telemetry work used UTM coordinates from forest cover maps.

4.0 RESULTS

We monitored live-trap sets at 81 locations (Appendix 3) in 2 general areas from 19 October 1996 to 17 March 1997. We established traplines in the northern portion (Chunamon/Raspberry Point area, the East and West Mains of the Mesilinka River, and the Finlay Forest Service Road (FSR) from Mesilinka Camp to km 148) and southern portion (FFSR from km 143 to km 102 and the Manson River) of the study area (Appendix 4). Traps were operational for 59,231 hours over 3,095 trap nights. Collapsible Havahart traps were used for 1,496 trap nights, permanent Havahart traps for 350 trap nights, barrel traps for 232 trap nights, and log-cabin traps for 1,017 trap nights.

4.1 Captures

We captured animals on 291 occasions at 59 traps (Table 1). We captured 8 fishers on 18 occasions at 11 different traps (4 Havahart and 7 log-cabin traps) throughout the study area. Two additional fishers were trapped outside the study area in the BWBSdk (Osilinka River drainage). Wolverines were captured 7 times at 4 log-cabin and 1 barrel traps. We caught martens 259 times at 50 trap sites (222 captures in Havahart, 31 captures in log-cabin, and 6 barrel traps). We also trapped 6 red foxes *(Vulpes vulpes)* and one red squirrel *(Tamiasciurus hudsonicus)*.

We recorded an overall capture rate of 0.54 fishers per 100 trap nights. Capture rates ranged from O fishers per 100 trap nights in October and December to 1.06 fishers per 100 trap nights in February (Fig. 2). We recorded the most captures in mid-February 1997; we caught fishers on 7 occasions from 13 February to 24 February (12 nights). Mean monthly temperature was not significantly related to monthly capture rates (linear regression, $r^2 = 0.09$, $P < 0.55$, Fig. 3). Fishers were captured at frequencies that were not significantly different than expected in each of 4 temperature categories ($x^2 = 1.46$, df = 3, $P < 0.69$, Fig. 4). Monthly capture rates also did not appear to have a relationship with the number of operational traps (Fig. 5).

We recorded 0.33 captures of fishers per 100 trap nights in Havahart traps and 1.18 fishers per 100 trap nights in log-cabin traps. Barrel traps did not capture any fishers. Among the three trap types, fishers were captured at frequencies significantly different than expected, based upon the number of trap nights of each trap type ($x^2 = 9.68$, df = 2, $P < 0.01$). Log-cabin traps captured fishers more frequently than expected (Bonferroni-adjusted Z-test, SE = 0.111, $P < 0.01$), while Havahart traps captured significantly fewer fishers than expected (Bonferroni-adjusted Z-test, SE = 0.111, $P < 0.05$).

We also captured wolverines at a rate of 0.56 captures per 100 trap nights (log-cabin and barrel traps only). We experienced very high capture rates for martens (8.37 captures per 100 trap nights) among all trap types. We closed or removed sets at four locations because of repeated captures of martens. We also recorded four mortalities of martens in the traps that we were monitoring. Two

Table 1. Frequency of capture of each species by trap type from 19 October 1996 to 17 March 1997, Williston Fisher Inventory Project.

Species	Havahart collapsible	Havahart permanent	Log-cabin	Barrel
Fisher	5	1	12	0
Wolverine	0	0	5	2
Marten	201	21	31	6
Red fox	3	1	2	0
Red squirrel	1	0	0	0

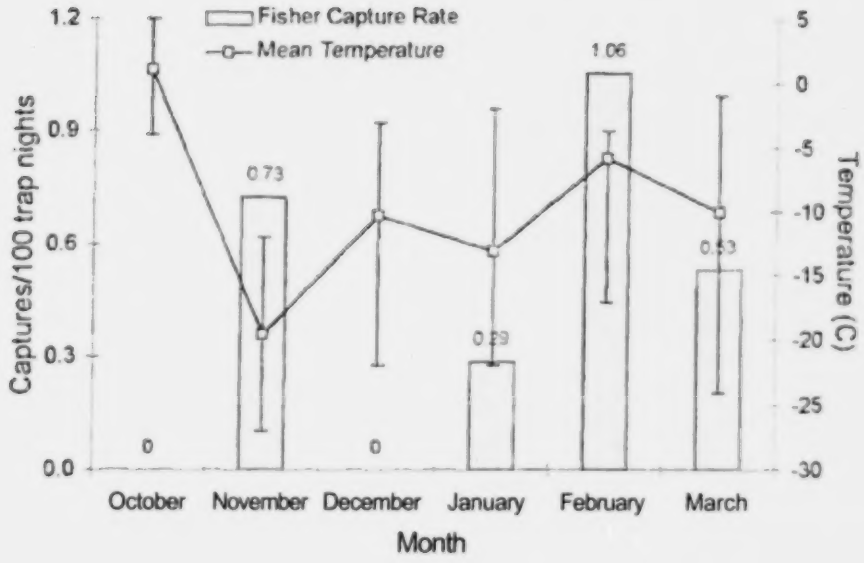


Figure 2. Capture rates of fishers and monthly temperatures from 19 October 1996 to 17 March 1997, Williston Fisher Inventory Project. Mean temperatures and ranges are shown for each month.

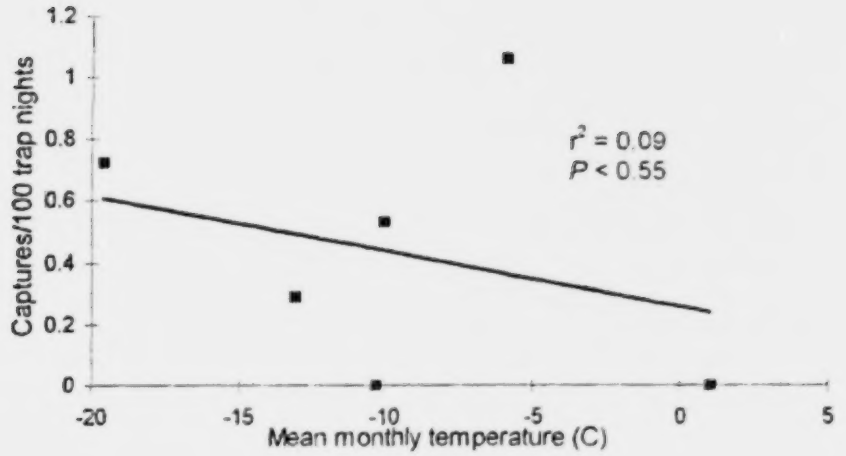


Figure 3. Relationship between mean monthly temperature and monthly capture rate of fishers, 19 October 1996 - 17 March 1997, Williston Fisher Inventory Project.

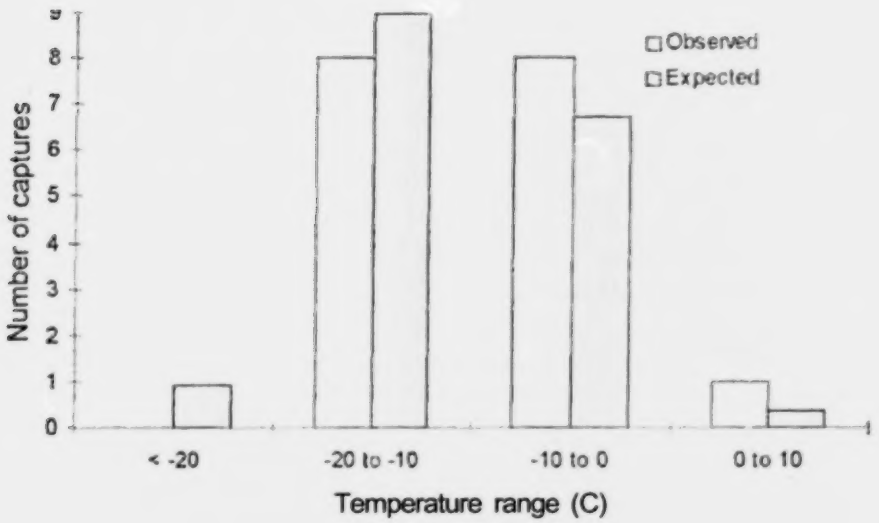


Figure 4. Observed and expected capture frequencies of fishers with respect to temperature for fishers trapped between 15 November 1996 and 07 March 1997, Williston Fisher Inventory Project.

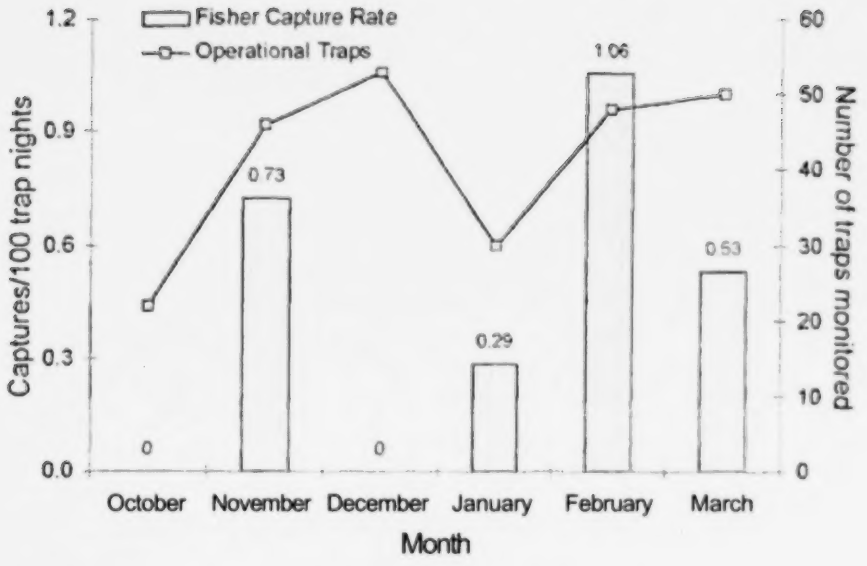


Figure 5. Number of operational traps and capture rates of fishers during each month from 19 October 1996 to 17 March 1997, Williston Fisher Inventory Project.

Table 2. Rate of malfunction (occurrences per 100 trap nights) by trap type during 3,095 trap nights from 19 October 1996 to 17 March 1997, Williston Fisher Inventory Project.

Malfunction type	Havahart collapsible (1,496 trap nights)	Havahart permanent (350 trap nights)	Log-cabin (1,017 trap nights)	Barrel (232 trap nights)
Blocked	4.81	2.86	9.43[a]	2.15
Tripped	3.81	3.71	1.08	2.15
Escaped	0.07	0.57	0	0

[a] includes "rebait"

mortalities occurred during periods of cold temperature (< -20 C) in November, while the other two marten died when the temperature was near O C.

4.2 Trap malfunctions

We recorded 58 traps malfunctioning 272 times (Table 2). Havahart collapsible traps were blocked 72 times (4.81 malfunctions/100 trap nights), while permanent Havahart traps were blocked 10 times (2.86 malfunctions/100 trap nights). Collapsible traps were tripped 57 times (3.81 malfunctions/100 trap nights) and permanent traps were tripped on 13 occasions (3.71 malfunctions/100 trap nights). Log-cabin and barrel traps accounted for 117 malfunctions (9.37 malfunctions/100 trap nights). Wolverines were likely responsible for the 3 escapes that we recorded in Havahart traps.

The rate of malfunction was significantly different from expected for each trap type, based upon the number of trap nights that each trap type was set (x^2 = 9.83, df = 3, P < 0.02). Log-cabin traps malfunctioned more frequently than expected (Bonferroni-adjusted Z-test, SE = 0.009, P < 0.01), while barrel and permanent Havahart traps malfunctioned less frequently than expected (Barrel traps, Bonferroni-adjusted Z-test, SE = 0.003, P < 0.01; permanent Havahart traps, Bonferroni-adjusted Z-test, SE = 0.005, P < 0.01). The frequency at which collapsible Havahart traps malfunctioned was not significantly different than expected (Bonferroni-adjusted Z-test, SE = 0.009, P > 0.5).

4.3 Mortalities

Several mortalities occurred in the study area. One fisher was accidentally killed in a log-cabin trap as the trap was inspected. The adult female fisher lunged forward as the researcher lifted the door to the trap, startling him, at which point he released the door. The door fell and crushed the fisher's skull. A necropsy later confirmed that the door caused massive trauma to the frontal portion of the skull, likely resulting in immediate unconsciousness of the animal. Also of note: the fisher had slight haemorrhaging of the small intestine, indicating possible hypoglycaemia prior to death. Dr. Helen Schwantje suggested that hypoglycaemia may have resulted from reduced feeding, despite the presence of meat in the trap, caused by anxiety while in the trap, in conjunction with a food source that is difficult to digest. Dr. Schwantje has suggested that a source of sugar (e.g., jam) in the traps would likely remedy this situation.

One radio-collared fisher died during the monitoring period. Fraser (F30) was consumed by a wolverine between 27 February and 26 March 1997. We were unable to determine whether the wolverine killed the fisher or scavenged the carcass. The entire carcass was consumed, except for the lower jaw and radiocollar.

Several unmarked fishers were also incidentally harvested in the study area during the 1996-97 trapping season by registered trappers. Three fishers (2 adult males, 1 adult female) were trapped at the start of the trapping season (November) in 738T009: 1 fisher each at 156 km and 149 km on the Finlay FSR and one on the Chunamon Mainline at 6 km. Two fishers (both males) were trapped on 729T005, in the Blackwater Creek portion of the study area. All of the

fishers that were taken by trappers were caught in Conibear 110 or C120 Magnum sets intended for martens.

4.4 Immobilisations

Of the 11 fishers that were captured within the study area, all but three were successfully immobilised and handled (Appendix 5). At the first capture of the year (15 November 1996), we captured a large fisher at a Havahart set at 148 km on the Finlay FSR. Unfortunately, while encouraging the fisher into the handling cone, it squeezed out between the canvas of the handling cone and the side of the trap. One additional fisher escaped through a hole under the raised door of a log-cabin trap at 149 km on the Finlay FSR as the trap was inspected. The one remaining unsuccessful handling was the mortality listed in section 4.3. Two fishers that were captured outside of the study area were both successfully handled.

We used two different techniques for handling and immobilising fishers, depending upon the type of trap. Drugs were administered using either a handling cone and hand-injecting the drugs for captures in Havahart traps, or a jab-stick in log-cabin traps. Fishers were easiest to handle when using a handling cone with Havahart traps, but appeared to remain more calm in log-cabin traps. Because handling cones physically restrained the fishers, the process of administering drugs was fast and effective. In log-cabin traps, the fishers were able to move around the inside of the trap, so positioning the animal so that drugs could be injected intramuscularly occasionally took several minutes. Because fishers were able to move around the trap, fishers were able to attack the jab-stick or injection sites were missed and the syringe needed to be reloaded.

We captured and processed 6 female and 2 male fishers (Table 3) in the study area from 18 November 1996 to 7 March 1997. Of the two fishers captured outside the study area, a male was captured on 22 February 1997 and a female was captured by Wolverine Project personnel on 13 April 1997, after we had finished trapping for fishers. Fishers ranged in size from 2.5 kg (Patches [F02]) to 5.8 kg (Haden [F01]). Ketaset/Rompun was used to immobilise 2 fishers, while Telazol was administered to the remaining 8 fishers. The mean dosage for the Ketaset/Rompun was 13.9 mg/kg (n = 2, SE = 0.1), while Telazol was 16.3 mg/kg (n = 7, SE = 2.0). These dosages produced anaesthesia ranging from 35 minutes to several hours. The female that was immobilised on 13 April was administered 9.1 mg/kg of Telazol to minimise the duration of anaesthesia. One premolar tooth was successfully removed for ageing purposes from only two of the 10 fishers that were immobilised. Blood was not successfully collected from any of the 4 fishers for which this procedure was attempted.

The female fishers that we caught were significantly smaller than the males in many morphological measurements (Table 4). Females weighed significantly less than males (t-test, $t = 7.38$, $df = 8$, $P < 0.01$). The neck girth of females was significantly smaller than that of males (t-test, $t = 15.73$, $df = 6$, $P < 0.01$), as was chest girth (t-test, $t = 6.63$, $df = 8$, $P < 0.01$). Head depth and circumference were also significantly smaller for females than males (head depth: t-test, $t = 2.59$, $df = 4$, $P < 0.03$; head circumference; t-test, $t = 6.94$, $df = 6$, $P < 0.01$).

Table 3. Dates and locations of captures and successful immobilisations of fishers between 19 October 1996 and 13 April 1997, Williston Fisher Inventory Project. All captures of fishers in Havahart traps were in the collapsible type.

Name	Sex[a]	Estimated age[b]	ID	Collar Frequency (MHz)	Date trapped	Trap site	Trap type
Patches	F	J	F02	148.132	18/11/96	Finlay 102	Havahart
Cali	F	A	F04	148.102	28/11/96	Manson 15	Log-cabin
Beau	M	A	F01	148.060	04/02/97	Finlay 156	Log-cabin
Solo	F	J	F05	148.145	13/02/97	Meadow Ck	Log-cabin
Haden	M	A	F08	148.041	14/02/97	Lower Donna Ck	Log-cabin
Inka	F	A	F07	148.113	21/02/97	Finlay 106	Log-cabin
Fraser	M	A	F30	148.573	22/02/97	Tenakihi 17.5	Log-cabin
Amelia	F	A	F03	148.162	24/02/97	West Main 12	Havahart
Olsie	F	A	F09	148.182	07/03/97	S. Muscovite 2	Havahart
Frankie	F	A	F16	148.312	13/04/97	Osilinka 15.5	Log-cabin

a F = female, M = male
b A = adult, J = juvenile

Table 4. Morphometric comparisons between female and male fishers captured between 19 October 1996 and 13 April 1997, Williston Fisher Inventory Project.

	Female			Male		
	Mean	± SE	*n*	Mean	± SE	*n*
Weight (kg)	2.8	0.1	7	5.1	0.4	3
Neck girth (cm)	17.5	0.2	5	23.7	0.4	3
Chest girth (cm)	23.2	0.7	7	30.5	0.3	3
Head depth (cm)	5.4	0.3	4	6.9	0.4	2
Head circumference (cm)	20.2	0.6	5	27.9	1.1	3

4.5 Recaptures

We recaught 3 fishers on 7 occasions at 5 traps within the study area. After initially being captured in the Havahart trap, Patches (F02) was retrapped once in each of the Havahart and log-cabin sets at Finlay 102. Cali (F04) was recaptured 4 times at log-cabin traps: 3 times at Manson 15 and once at Manson 26. Solo (F05), originally captured at the log-cabin trap at Meadow Creek, was retrapped in the Havahart set at Finlay 121. Outside of the study area, Fraser (F30) was retrapped in the same log-cabin trap in which he was initially caught at Tenakihi 17.5.

All 4 fishers appeared to be in good physical condition at the time of recapture, except that 3 of the 4 fishers had lost eartags. Solo ripped one eartag out while she was in a Havahart trap, and Cali lost both of her eartags within 81 days of her initial ear-tagging. Fraser also lost one eartag in less than 12 days.

In addition to recaptures of radio-collared animals, we caught 2 fishers (Inka [F07] and Beau [F01]) that were marked by Wolverine Project personnel during February and March 1996. Inka did not have any eartags remaining in either ear and Beau had only one of his original 2 eartags. Extensive scarring and missing portions of the external ear occurred where the eartags had torn through. In all other respects, both of these fishers were in good physical condition. Inka was given one eartag in her right ear, which had the least amount of scarring.

4.6 Radiotelemetry monitoring

We located radio-collared fishers from the air 84 times between 21 November 1996 and 24 April 1997, during 140 attempts (60.0% success rate) in 22 flights (Appendix 6). Although we were often unable to locate all radiocollars on each flight, most fishers were located at least 5 times (Table 5). Haden was not located from the air following his initial capture and radio-collaring, despite extensive searches of the study area. Success rate for each telemetry flight ranged from 11.1% to 100% (Fig. 6).

We also attempted to locate fishers from the ground on 23 occasions between November and March. Other than locating maternal dens (5 locations), we were only able to locate fishers during 5 of these attempts (21.7% success rate).

4.7 Movements and habitat use

The range over which we recorded fishers moving varied considerably between individuals. During the monitoring period, fishers traversed between 1.4 km^2 and 132.0 km^2 (100% minimum convex polygon), with the mean area traversed during monitoring being 33.4 km^2 (SE = 13.5, n = 10, Table 6). The mean range was 84.5 km^2 (SE = 47.5, n = 2) for males and 18.8 km^2 (SE = 8.5, n = 8) for females.

We evaluated the difference between coordinates for locations estimated with aerial GPS compared to those estimated by plotting locations on 1:20,000 forest

Table 5. Number of aerial telemetry locations obtained for each radio-collared fisher during 22 flights between 21 November 1996 and 24 April 1997, Williston Fisher Inventory Project.

ID	Name	Date collared	Number of locations	Number of attempted locations	Success rate (%)
F03	Amelia	24/02/97	12	14	85.7
F09	Olsie	07/03/97	10	12	83.3
F16	Frankie	13/04/97	5	6	83.3
F02	Patches	18/11/96	16	22	72.7
F01	Beau	04/02/97	11	17	64.7
F07	Inka	21/02/97	9	14	64.3
F05	Solo	13/02/97	9	15	60.0
F04	Cali	28/11/96	10	20	50.0
F30	Fraser	22/02/97	2	5	40.0
F08	Haden	14/02/97	0	15	0

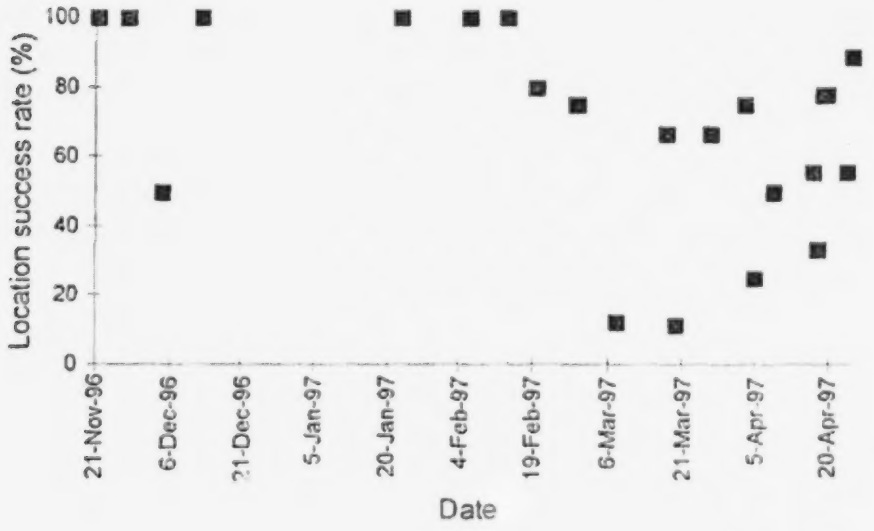


Figure 6. Rate of successful location of transmitters during telemetry flights for radio-collared fishers from 21 November 1996 to 24 April 1997, Williston Fisher Inventory Project.

Table 6. Area traversed by radio-collared fishers from 21 November 1996 to 24 April 1997, Williston Fisher Inventory Project.

Name	ID	Number of locations[a]	Area traversed[b] (km^2)
Patches	F02	19	11.3
Cali	F04	20	71.3
Beau	F01	12	132.0
Solo	F05	13	18.0
Haden	F08	2	N/A
Inka	F07	10	5.2
Fraser	F30	5	37.0
Amelia	F03	13	18.5
Olsie	F09	12	6.3
Frankie	F16	6	1.5

a includes captures, aerial telemetry, and ground telemetry
b 100% minimum convex polygon (Mohr 1947)

cover maps. The mean difference between GPS and map locations was 330 m (SE = 84, n = 5).

We recorded fishers using a variety of stand types during aerial telemetry flights. Fishers were most frequently located in riparian and riparian-associated habitats dominated by large hybrid spruce and black cottonwood trees (23 of 84 locations, 27.4%). Because of the large error associated with the GPS locations, a representative sample of locations was not available for any habitat use analyses.

We located natal dens of 4 female fishers (Cali [F04], Inka [F07], Amelia [F03], and Frankie [F16]) during April. All of the dens were in large diameter, declining black cottonwood trees located in riparian or riparian associated habitats. To reduce the likelihood of the females abandoning their kits because of human disturbance, we only identified the natal den trees and did not measure or otherwise disturb the area around the trees.

5.0 DISCUSSION

Trapping success of fishers varied dramatically throughout the trapping season. Although we began trapping intensively in October 1996, the majority of fishers were trapped in February and March 1997. All but three of the fishers that we captured were radio-collared and ear-tagged. The capture success for each month did not have appear to have a relationship with either the number of traps operational nor the mean monthly temperature. Log-cabin traps captured fishers

more frequently than expected, while Havahart traps captured fishers less frequently than expected.

5.1 Capture success

The capture rate of 0.58 fishers per 100 trap nights that we documented in this study was lower than most other live-trapping programmes (Table 7). Johnson (1984) reported 1.59 captures per 100 trap nights in Wisconsin, but this figure included roughly the same number of recaptures as original captures. The rate observed in this study was similar to that recorded elsewhere in British Columbia (approx. 0.40 captures/100 trap nights, R.D. Weir, Unpubl, data). Several mitigating factors, such as weather, seasonal influences, habitat suitability, trapline size, and trap type likely influenced the capture rate that we documented.

5.1.1 Weather and seasonal influences

Only 2 other studies have reported changes in capture success over the trapping season (Table 8). Johnson (1984) noted that captures of fishers in Wisconsin ranged from 0.2 captures/100 trap nights during December/January to 3.0 captures/100 trap nights during February/March. Arthur (1987) noted a similar trend with wire-mesh cage traps, with capture success peaking during October (2.86 captures/100 trap nights) and March (1.40 captures/100 trap nights). Capture rates of fishers elsewhere in British Columbia peaked during October and March (R.D. Weir, unpubl. data). In the Williston area, the capture success of fishers also peaked twice during the trapping season, but during November and February/March. Several factors may have influenced the changes in capture success that we observed during the trapping season.

The capture rates during the 1996-1997 trapping season were likely result of changes in the behaviour (and activity) of fishers through the winter. The rate of activity (and catchability) of fishers likely changes because two factors: 1) fluctuations in the activity and availability of prey, and 2) changes in movement patterns.

The activity of prey species is likely closely related to several environmental parameters. When ambient temperatures climb above O C, prey such as snowshoe hares, squirrels, and microtine rodents probably become more active on the surface of the snow than they do during periods of colder weather. The characteristics of snow cover can also influence the manner in which potential prey items use their environment. For example, microtine rodents likely gain both thermal and foraging benefits using subnivean tunnels during periods of cold temperatures and deep, soft snow. These changes in catchability (Buskirk and Powell 1994) likely affect the foraging behaviour of fishers by increasing the time and distance that fishers spend foraging. This may in turn affect their susceptibility to traps.

The availability of prey also changes throughout the winter (Buskirk and Powell 1994), which may indirectly affect capture success. Prey populations decline during the winter because of losses due to mortality and negligible recruitment.

Table 7. Comparison of fisher capture rates reported from across North America.

Geographic area	Captures per 100 trap nights	Reference
Manitoba	0.10	Raine 1981
British Columbia	0.40	Weir, unpubl. data
British Columbia	0.58	this study
Minnesota	0.88	Roy 1991
Maine	1.07	Arthur 1987
Northern California	1.20	Zielinski et al. 1994
Wisconsin	1.59	Johnson 1984
Northern California	2.70	Buck et al. 1983

Table 8. Comparison of monthly capture rates of fishers observed in this study to rates reported elsewhere in North America. Capture rates are expressed as captures per 100 trap nights.

	Wisconsin (Johnson 1984)	Maine (Arthur 1987)		this study	
Month	Capture rate	Trap nights	Capture rate	Trap nights	Capture rate
Sep	2.00	622	0.64	0	N/A
Oct	2.00	1113	2.86	66	0
Nov	N/A	328	0.30	613	0.73
Dec	0.20	69	0	618	0
Jan	0.20	168	1.19	353	0.29
Feb	3.00	401	0.50	1047	1.05
Mar	3.00	859	1.40	641	0.53
Apr	N/A	646	1.24	0[a]	N/A
May	N/A	16	0	0	N/A

a Fisher captured outside of the study area but not considered in trap night data

Thus, as the winter progresses, fewer prey are available and fishers may need to search more widely to find adequate food.

Environmental factors likely affect the rate of activity of fishers during the trapping season as well. Fishers avoid activity during periods of extreme cold because of the increased heat loss and low prey availability during these periods (Powell 1982). In addition, deep soft snow that often accumulates during periods of cold inhibits movements by fishers (Raine 1981). Johnson (1984) attributed the low capture rate that he observed during December and January to low temperatures and deep snow. The low temperature and deep, soft snow that occurred during December and January in this study area may have reduced the activity rate of fishers. Consequently, decreased movements during this time may have negatively affected the capture rates of fishers.

Seasonal changes in movement patterns of fishers may also affect capture rates. Fishers tend to move around their home ranges more frequently during the pre-breeding period (February - March, Powell 1982). This increase in activity is believed to be the result of males attempting to locate future breeding opportunities (Arthur et al. 1989) and females indicating their reproductive status by scent-marking (Raine 1981). While traversing their home ranges, the probability of fishers encountering traps likely increases during this period.

It is important to note that trapping for fishers should not occur close to the whelping season (late March - early April, Weir 1995). Holding females captive that have whelped, even for a short while, may result in desertion of the kits. In Maine, Arthur (1987) trapped fishers during April and noted that several females that were live-trapped subsequently abandoned their litters. Consequently, future trapping efforts should cease by mid-March to avoid abandonment of kits by females.

5.1.2 Habitat suitability

Although habitat capability throughout the study area is generally quite high for fishers, the current suitability of habitat in the study area for fishers ranged from extremely high to very low. This may have influenced the capture rates that we observed over the trapping season.

Some sections of the study area have very high habitat suitability for fishers. The extensive riparian and riparian-associated habitats that occur on the wide floodplains of unlogged rivers in the study area (e.g., Manson River) have provided very good habitats for fishers. These areas are typified by large, declining black cottonwood trees and structurally complex forest floors. We captured 4 of the 10 fishers in these areas. At least 4 other fishers that we were unable to trap probably occur in riparian zones elsewhere in the study area. Areas with high habitat suitability for fishers include (Fig. 7):

- Manson River floodplain
- Meadow Creek / Eklund Creek riparian areas
- Upper and Lower Stranberg Creek
- Lower Eklund Creek (near Williston Reservoir)
- Lower Fries Creek (near Williston Reservoir)

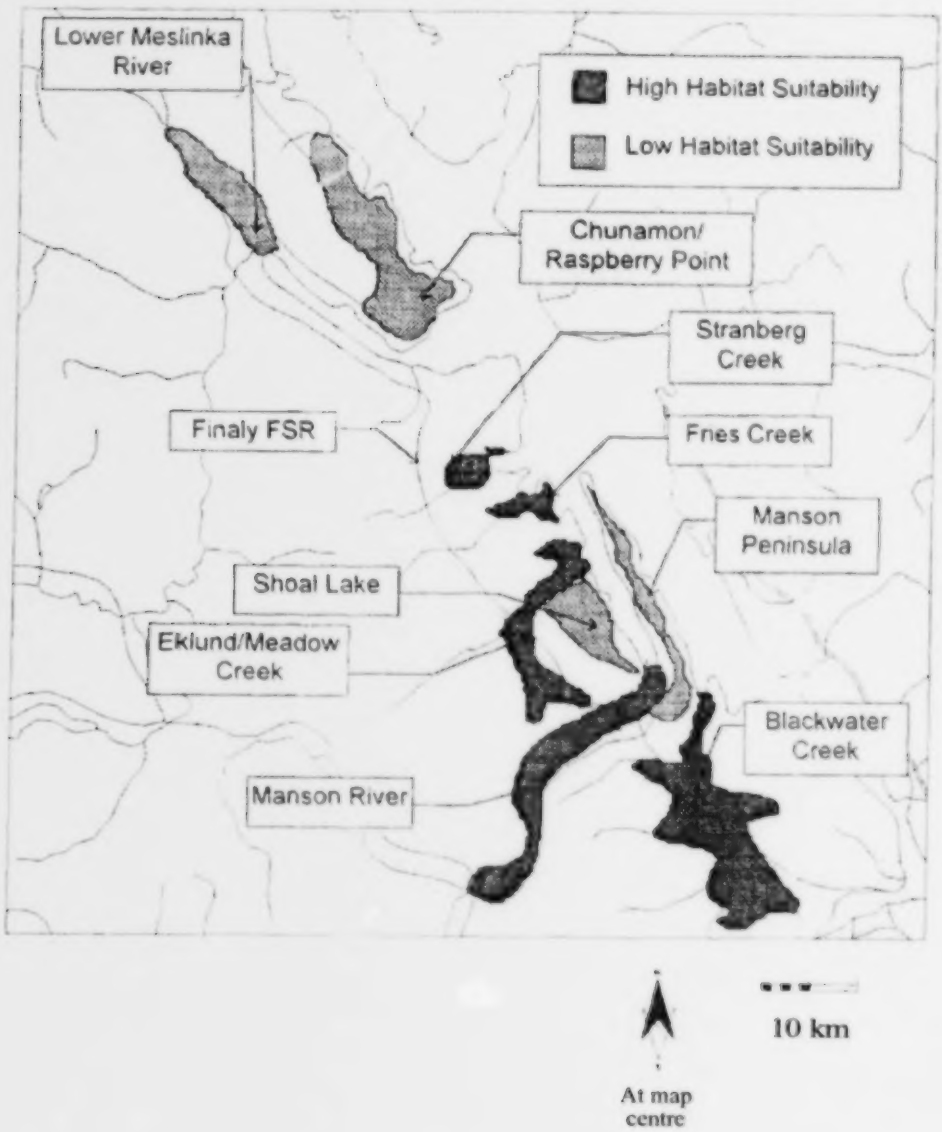


Figure 7. General habitat suitability for fishers of the study area, Williston Fisher Inventory Project.

- Blackwater Creek and 15 Mile Swamp

Much of the low suitability forests that occur in the study area resulted from harvesting of late-successional forests (e.g., hybrid spruce) and natural disturbance (e.g., fire). This resulted in a matrix of early seral stages amongst mid-successional lodgepole pine stands. Most of the SBSmk in this study area is dominated by large (> 100 ha) mid-successional (i.e., 40 - 80 years) lodgepole pine stands that are separated by strips of late-successional riparian corridors. Linkages between late-successional stands is poor and generally only occurs through riparian areas. The majority of late-successional forests in these upland areas have been harvested for timber in the past 25 years. Fisher habitat suitability in these areas would have been high, but harvesting of the late-successional components of the matrix and riparian corridors has likely diminished the ability of these areas to support fishers. Portions of the study area that have low habitat suitability for fishers include (Fig. 7):

- Mid-successional forests east of Shoal Lake, north of the Manson River floodplain, and south of Eklund Creek
- Manson Peninsula
- Chunamon / Raspberry point area
- Lower Mesilinka River floodplain

The variability in habitat suitability in the study area may help to explain the relatively low capture rate that we observed, when compared to other research studies. Investigations of fisher ecology generally only occur in areas where fisher densities are high, so that the researcher can be assured of an adequate number of radio-collared animals for the purposes of the research study. This likely leads to erroneously high capture rates that may not reflect capture rates over large areas.

Within the Williston study area, however, the habitat suitability for fishers was very heterogeneous. Because one of the goals of this study is to examine fisher ecology in managed landscapes, which includes low suitability habitats, the relatively low capture rate is not surprising. Our overall capture rate in highly suitable habitats was probably not significantly different from the success observed in other studies that were conducted solely in high suitability fisher habitats. We did incidentally observe fisher tracks at 7 locations throughout the study area. At 6 of these locations, we captured fishers. This evidence suggests that, in areas where fishers occur, the capture rate may be much higher than when it is averaged out over the entire study area.

5.13 *Trap type*

Most studies of fishers use cage traps to capture study animals. Wire box live traps, such as Tomahawk and Havahart models, are used in many studies (e.g., Powell 1977, Paragi 1990, Jones 1991), although some studies have reported also using padded leghold traps (Arthur 1987). We used primarily wire-mesh Havahart live traps on this study, but also log-cabin and barrel traps. None of the past studies or reports that we examined reported using either barrel or log-cabin traps.

Arthur (1988) was one of the few researchers to do a comprehensive analysis of live-trapping data comparing the capture rates among different trap types. He used 3 different live trap sets: padded leghold, wire box traps with radio-monitors, and wire box traps without radio-monitors. Over 8,299 trap nights, he reported 62 captures of 40 fishers. His mean trapping success was 0.12 captures/100 trap nights for legholds, 0.39 captures/100 trap nights for box traps without monitors, and 1.52 captures/100 trap night for traps with monitors. Arthur (1988) concluded that the reduced amount of disturbance at trap sites with monitors enhanced the capture success of these traps.

During this study, we observed the highest capture success with log-cabin traps. Eight of the 13 fishers that we caught were captured in log-cabin traps. Several attributes of the traps may have enhanced their capture success. Firstly, the entrance to log-cabin traps are much more open than either Havahart or barrel traps. Thus, the bait may be more obvious and fishers may accept the bait as being more available. Secondly, log-cabin traps are composed entirely of natural materials and fishers may be less wary of them. Finally, although the entrances to both Havahart and barrel traps may appear similar to access points to subnivean foraging areas, the look and smell of log-cabin traps may more closely resemble slashpiles and CWD spaces.

5.1.4 Trapline size and accessibility

We were unable to achieve as many trap nights for fishers as initially anticipated for several reasons. Although we had expected to monitor up to 70 traps simultaneously throughout the study area, co-ordination between the Fisher Project and the Wolverine Project occasionally decreased the amount of time allocated to checking fisher traps. However, this was somewhat ameliorated by the traps that researchers working for the Wolverine Project monitored (e.g., Manson FSR traps). Our ability to monitor traps was also reduced because we occasionally were needed to assist with immobilisations of wolverines and to train and assist Wolverine Project volunteers. As well, the availability of suitable fisher habitat in the northern portion of the study area was less than that in more southerly portions. Therefore, we had to travel greater distances between suitable trap sites, which negatively influenced the number of traps that we could monitor.

In addition, we experienced difficulty with the reliability of the snowmobiles that we used to monitor many of the traps. The snowmobiles that we used required servicing and repairs on 7 separate occasions during the course of winter field work. This resulted in our closing down traplines that we monitored via snowmobile for the remainder of that trapping session (up to 30 trap nights).

5.2 Trap efficacy

Several factors likely affected the efficacy of the trap types that we used. Each type of trap had particular problems associated with their design that resulted in malfunctions and thus influenced the capture rates that we observed.

Havahart traps had several design problems that resulted in frequent malfunctions. Because collapsible Havahart traps relied upon only 3 rods to keep

the sides of the trap straight, snow loads on top of the trap often buckled the sides of the trap. When this occurred, the door to the trap would not lock closed after the pan was tripped. Also, the traps relied upon the door passing a locking mechanism. Occasionally, ice would form on the top of the trap, freezing the locking mechanism open. This design problem did not occur with Havahart permanent traps, which rely upon a different locking mechanism. The rear of the collapsible traps was also held in place by a single rod and animals were occasionally able to escape by pushing on the rear of the trap and bending this rod. In addition, the cable system which connected the pan to the trigger on the collapsible trap was often too long and required modification. Some modifications to the collapsible traps may decrease the number of escapes, but problems with snow loads on the roof of the trap would still likely cause malfunctions. Both types of Havahart traps were consistently tripped by non-target species, particularly martens, which reduced the number of hours that traps were operational.

Log-cabin and barrel traps had relatively few malfunctions, although we did note one design flaw. The trigger mechanisms on both log-cabin and barrel traps were not sensitive to movement of the bait, therefore marten and other carnivores (potentially fishers) were often able to remove bait from the trap without releasing the trigger.

Many malfunctions for all trap types may not have been recorded because of the testing regime that we employed to assess the functioning of the trap. Traps could only be correctly classified as malfunctioning when we tested them. On days when we did not test the traps, we may have misclassified malfunctioning traps as empty but operational.

However, checking each trap on a daily basis may present two logistical difficulties. Firstly, repeated manipulation of the trap mechanisms may increase the likelihood that human scent will be left at the trap site. This may negatively influence the efficacy of the trap by affecting the probability of fishers entering traps (Arthur 1988). Secondly, the increase in time required to assess each trap thoroughly may result in less time being available to check traps and a net reduction in the total number of traps that could be monitored. More diligent cleaning and preparation of the trap site may reduce the likelihood of trap malfunctions, especially for Havahart collapsible traps.

5.3 Non-target species

We captured non-target species in many of the traps that we monitored. The repeated captures of martens probably reduced our capture success for fishers. However, capturing martens and other species in Havahart traps set for fishers is difficult to avoid.

One possible solution is to increase the use of log-cabin traps, which appear to be less able to capture martens. However, if log-cabin traps are to be used in future trapping seasons, we will need to ensure that the bait in the traps is checked regularly. In addition, the construction of log-cabin traps is far more labour intensive and requires a great deal more preparation time.

Another alternative is to have two traps at each trap sites. If two traps are set and one trap is tripped by a non-target species, the other trap would still be operational. Since Havahart traps seem to trap martens easily, having a Havahart and a log-cabin trap at each site may decrease the number of trap nights lost to martens.

5.4 Mortalities

Several fishers that may have been potentially captured and marked died in Conibear traps which were set for martens by trappers. These mortalities may be avoided in the future if trappers agree to use boxes for their marten traps which will capture martens, but exclude fishers. The design for the boxes would be the same as is currently used by the trappers but with an additional plate on the front with a hole that martens can crawl through, but fishers cannot. The diameter of the hole should be no larger than the lower 95% confidence interval of the width of the zygomatic arch of female fishers (data available from R. Weir).

Changes to the procedures used to assess captures in log-cabin traps will help avoid future mortalities. The use of locking tie-downs to open the door to the trap would allow the investigator to open the door of the trap to a controlled height and keep the door locked in a specific position.

The death of one male fisher appeared to have occurred through natural mortality. Very few authors have noted natural mortality among fishers, although Roy (1991) reported that wolverines did kill transplanted fishers in Montana. Male fishers occasionally kill females while mating (Weir, pers, obs.) and intraspecific confrontations can sometimes be fierce, especially during the mating season (Powell 1982, Arthur 1987).

5.5 Immobilisations

We used Ketaset/Rompun or Telazol to immobilise fishers. We attempted to administer Ketaset/Rompun to the fishers at dosages similar to those reported elsewhere in the literature (Table 9). However, we often over-estimated the weight of fishers in log-cabin traps, so the dosages that we administered were occasionally more than anticipated. The resulting dosages of Telazol maintained a level of anaesthesia that was slightly too deep. A slightly lower dosage (e.g., 10 mg/kg Telazol) would likely maintain an adequate level of anaesthesia for our handling purposes.

We observed several advantages with the use of Telazol compared to Ketaset/Rompun. Telazol induced anaesthesia at about the same rate as Ketaset/Rompun (3 min.), however respiratory rate was much more constant throughout the entire immobilisation (38 breaths/min). With Telazol, we observed very high heart rates while the fishers were immobilised (> 140 beats/min), but these rates may be typical for fishers (H. Schwantje, pers, commun.).

When immobilised with Telazol, one fisher became hypothermic. We observed a rapid decrease in body temperature during Patches' (F02) anaesthesia (from 40 C to below 36 C in 15 min), which resulted in convulsive shivering. The ambient temperature during the immobilisation was -17 C. Although we were able to

Table 9. Drug types, dosages and duration of immobilisation for fishers reported in the literature.

Geographic area	Drug type	Dosage	Duration immobilised	Reference
Wisconsin	ketamine	22 mg/kg	17 - 57 min	Johnson 1984
Montana	ketamine & xylazine	22 mg/kg (ketamine) 2 mg (xylazine)	N/A	Roy 1991
Manitoba	ketamine & acepromazine	15-20 mg/kg (ketamine) 2.5 mg (acepromazine)	N/A	Raine 1981
Manitoba	fentanyl & dropsridol	N/A	N/A	Leonard 1980
New Hampshire	ketamine & acepromazine	15-20 mg/kg (ketamine) 2.5 mg (acepromazine)	N/A	Kelly 1977
Idaho	ketamine	N/A	N/A	Jones 1991
northern California	ketamine & acepromazine	11-17 mg/kg (ketamine) 1 mg (acepromazine)	N/A	Buck et al. 1979
Maine	ketamine	20-60 mg/kg	20 - 120 min	Arthur et al. 1988
British Columbia	ketamine & xylazine	20 mg/kg (ketamine) 2 mg/kg (xylazine)	45 - 90 min	Weir 1995
British Columbia	tiletamine: zolazepam	16 mg/kg	35 - 180 min	this study
British Columbia	ketamine & xylazine	12 mg/kg (ketamine) 1.4 mg/kg (xylazine)	15 - 40 min	this study

regain normal body temperature, future immobilisations during cold weather should use hot water bottles or some other heat source to help fishers thermoregulate. Despite this disadvantage, Telazol performed well for immobilising fishers and had a wide safety margin.

Not all of the information that was intended to be compiled during each immobilisation was collected. Blood samples were not collected because none of the personnel had any prior experience drawing blood and felt uncomfortable attempting to do so without any previous instruction or attempts. A premolar tooth was not collected from some of the fishers for similar reasons.

5.6 Recaptures and marking

We recaptured fishers on several occasions throughout the study area. Two fishers were recaptured repeatedly. The rate of recapture that we observed in this study is higher than that recorded elsewhere in British Columbia (R.D. Weir,

unpubl. data), which is encouraging for future recollaring efforts. Log-cabin traps may be the best trap type for recapturing fishers.

The methods of marking that we used in this study had varying levels of permanence. Eartags were lost at an alarming rate and may not be a suitable technique for marking fishers. The size and orientation of eartags may not be an appropriate method of marking for a species that dwells on the forest floor and pursues prey through structurally complex habitats. As evidenced at the recapture of Solo (F05), eartags are prone to becoming snagged and rip out of the pinnae of the ear. Other researchers have also reported that eartags are not a reliable marking method; Arthur (1988) recorded that most fishers in Maine lost 1 or both tags over 3-12 months. He also observed that many fishers had scars from eartags, but several recaptured fishers showed no signs of having been ear-tagged. Tattooing and radio-collaring may be the most reliable methods of marking fishers for future identification during this study.

5.7 Radiotelemetry

Several factors influenced our success collecting radiotelemetry information. One of the greatest difficulties that we encountered while attempting to locate radiocollars from the air was the limited range over which signals from the transmitters could be received. For the majority of the 10 transmitters that we used, the reception range varied from 1 - 3 km from the air.

The GPS error that we observed may be due to the use of different datum systems. The base maps that we used for this study were derived from North American Datum of 1927 (NAD27). However, some of the maps that we operated from were generated with North American Datum of 1983 (NAD83). The GPS that we used during aerial telemetry may have reported locations using World Geodetic System of 1984 (WGS84). We are currently determining a method for transforming locations between datum systems. We need to consistently use one standard datum system for all locational data. The use of aerial photos would help alleviate this problem.

During the trapping season, we were unable to monitor Patches, Inka, Cali, Beau, Solo, or Haden from the ground because their home ranges occurred on trap lines that were monitored by personnel from the Wolverine Project. Because the focus of the field effort was directed towards maintaining traplines and attempting to access new areas, we were unable to spend sufficient time locating these animals from the ground.

Following the trapping season, we were able to allocate more time to monitoring the radio-collared fishers from the ground. However, the signals from the transmitters were often difficult to detect and we were unable to locate many of the fishers consistently. Occasionally, we were scarcely able to pick up signals from fishers that were as close as 200 m away when monitoring from the ground.

The design of future radiocollars should be changed to enhance transmission distance. This can likely be accomplished by increasing the power output (larger battery) and coiling a full-sized antenna around the webbing of the collar (perhaps using commercial shrink-wrap). Future effort should also be directed to determining whether the existing radiocollars can be altered to enhance

transmission distance. Perhaps removing the antenna from within the collar material and reconfigure it around the collar itself, using commercial shrink-wrap. Blind transmitter trials should be used following any modifications to assess changes in the function of the radiocollars.

5.8 Movements and habitat use

Initial locations indicated that resident female fishers appear to have small home ranges centred around riparian habitats. Patches (F02) was repeatedly located in a stand of hybrid spruce and black cottonwood directly to the east of the Finlay FSR on the Manson River. Our preliminary estimate of her home range (100% minimum convex polygon, sensu Mohr 1947) was 11.3 km^2, but this was based on only 19 locations. The estimate of Cali's (F04) range was larger (71.3 km^2), and was based on 20 locations. Male ranges tend be larger, as reported elsewhere (Powell 1982).

However, most of the ranges that were calculated are estimated on both winter and breeding home ranges. Home range calculations require a minimum of 20 locations in one season to be considered somewhat accurate (Seaman and Powell 1991). Therefore, these estimates of ranges do not reflect the true home range of each animal and should only be used as an indication of the level of site fidelity that was observed during the monitoring period. Continued monitoring will provide enough data so that accurate home range analyses can occur.

The use of stand-level habitats by the radio-collared fishers appeared to be consistent with those patterns reported by Weir (1995). The majority of fisher locations occurred either in or near riparian or riparian-associated habitats. Many of the locations of several fishers appear to be concentrated in late-successional forested floodplains of the major rivers in the area. For example, Patches (F02), Cali (F04), and Inka (F07) were all located consistently on the hybrid spruce/black cottonwood floodplain of the Manson River, while Amelia (F03) was recorded most frequently on the floodplain of the Mesilinka River.

The five natal dens that we recorded during April all occurred in large diameter, declining black cottonwood trees. This result is consistent with the other study of fisher ecology in British Columbia (Weir 1995), which suggest that black cottonwood trees have several beneficial characteristics that make them suitable for rearing kits.

The small range over which the radiocollars transmitted signals could potentially bias habitat and spatial organisation data collected from ground telemetry because one cannot assume that the likelihood of locating a transmitter is independent of the location of the transmitter. For example, if one is only able to detect a transmitter within 300 m of a road, locations will only be collected in those instances when the transmitter is within that area. The transmitter will not be located if it is greater than 300 m from the road. Thus, any data that is collected will suggest that the animal spends all of its time within this corridor, which may not be true. The only way to alleviate this bias is to rely solely on aerial telemetry, for which the likelihood of detection is relatively independent of the location of the transmitter, until the fishers are collared with different transmitting units.

6.0 RECOMMENDATIONS

6.1 Trapping

- Trap intensively for fishers between January and March. Biotic, abiotic, and behavioural factors during this period likely increase the likelihood of captures.
- To maximise capture success, future trapping effort should be concentrated in areas with contiguous, late-successional forests with a large component of riparian and riparian-associated habitats. However, in an attempt to radio-collar fishers that may live in low suitability habitats, traps should also be established in similar patches that remain within these areas.
- During October - December, perform track surveys in areas with moderately to highly suitable habitat to determine presence/absence of fishers. Establish trap sites in areas where fisher tracks are recorded.
- Expand traplines to include inaccessible areas of river floodplains where uncollared fishers may occur. This may require allocating resources to cut and establish snowmobile trails through unroaded forests. Aerial photography and surveys should be used for reconnaissance in potential areas.
- Use trap transmitters to monitor as many traps as possible *(sensu* Arthur 1987). The reduction in human disturbance of the trap site may enhance capture success.
- For future recollaring efforts, 2 log-cabin traps should be constructed in riparian habitats in the home range of each radio-collared fisher. Two traps will probably expedite recapture, although one log-cabin trap would likely eventually capture the individual.
- The trigger mechanism of the log-cabin trap needs to be re-evaluated. Perhaps using a bait source-trigger mechanism that is more protected from freezing may alleviate the problem of frozen triggers.
- Strengthen collapsible Havahart traps by wiring together joints and adding additional support to the brackets and rods.
- Place a Havahart trap at each log-cabin trap to reduce the number of trap nights lost to non-target species.
- More diligent cleaning and preparation of the trap site may reduce the likelihood of trap malfunctions, especially for Havahart collapsible traps.
- The use of locking tie-downs to open the door to the trap would allow the investigator to open the door of the trap to a controlled height and keep the door locked in a specific position.
- Jam should be placed in traps to act as a source of sugar for animals. This should reduce the probability of trapped animals developing hypoglycaemia and incidental mortality.

- Produce a standardised trapping methodology and classification system. Use a standardised trapping data form for both fisher and wolverine traps.

6.2 Immobilisation and handling procedures

- Use Telazol at 10 mg/kg for all future immobilisations. Record dosage, duration of anaesthesia, body temperature, and cardiac and respiration rate at regular intervals through the procedure. Results from immobilisations should be published in scientific journals as a reference for future research on fishers.
- Provide in-the-field training for all personnel on immobilisation procedures, especially for collecting blood samples and removing premolar teeth.
- Provide a written standardised methodology and check-list of data that needs to be collected for each immobilisation.
- Future immobilisations during cold weather (i.e., < -15 C) should use hot water bottles or some other heat source to help fishers maintain body temperature above 36.5 C and prevent hypothermia.

6.3 Radiotelemetry, radiocollars, and marking

- The design of future radiocollars should be changed to enhance transmission distance. This can likely be accomplished by increasing the power output (larger battery) and coiling a full-sized antenna around the webbing of the collar (perhaps using commercial shrink-wrap).
- Determine whether Holohil radiocollars can be altered to enhance transmission distance. Perhaps removing the antenna from within the collar material and reconfigure it around the collar itself, using commercial shrink-wrap. Perform blind transmitter trials to assess changes in the function of the radiocollars.
- Solely rely upon aerial telemetry for habitat use and home range estimates until unbiased sampling can be ensured (i.e., fully functional radiocollars) from ground telemetry.
- Plot all aerial telemetry locations on large-scale air photos or 1:20,000 forest cover maps and use a common geographic datum (e.g., NAD27) for all locational data. Record all telemetry locations and stations in UTM coordinates. Field personnel should be supplied with airphotos for the study area in order to effectively identify good fisher habitat, and thus good trap locations, as well as to accurately and precisely map telemetry locations.
- Discontinue using eartags as *a* method of permanently marking individuals. Continue with tattooing the inguinal region with an identification number.

6.4 General

- Field personnel for fisher project should be stationed closer to the Manson River, where 5 of the 9 fishers are resident and most of the suitable fisher habitat occurs. This will reduce the amount of time, fuel, and costs of travel

from Mesilinka Camp to the Manson River (100 km one-way, about 3.5 hours travel/day). Munro Camp is the closest potential area.

- Contact trappers to determine if they will use marten boxes modified to exclude fishers during upcoming trapping seasons. Construct boxes that will exclude fishers from Conibear 110 and C120 Magnum sets for the trappers to use on their traplines. This will reduce the number of incidental captures of fishers, but still allow the trappers to harvest martens.

7.0 CONCLUSIONS

The study area supports a population of at least 8 fishers, but the majority of fishers and fisher habitat occur in the southern portion of the study area, which was not adequately trapped during the first year. Capture success was much less than anticipated, but this may have been influenced by temperature, seasonal changes in movement patterns, trap type, and habitat suitability at the trap sites. Of the 10 fishers that were radio-collared, we were able to locate 6 consistently. The death of one male fisher appeared to have occurred through natural mortality. Generally, ranges and the use of habitats by fishers in this study are consistent with that recorded elsewhere in British Columbia.

8.0 LITERATURE CITED

Arthur, *SM.* 1987. Ecology of fishers in south-central Maine. Ph.D. Thesis, University of Maine, Orono. 111pp.

_____. 1988. An evaluation of techniques for capturing and radiocollaring ~ fishers. Wildl. Soc. Bull. 16:417-421.

_____, W.B. Krohn, and J.R. Gilbert. 1989. Home range characteristics of adult " fishers. J. Wildl. Manage. 53:674-679.

Banci, V. 1987. Ecology and behaviour of wolverine in Yukon. M.Sc. Thesis, Simon Fraser University, Burnaby, B.C. 178pp.

B.C. Ministry of Forests. 1993. Field guide for site identification and interpretation for the northern Rockies portion of the Prince George Forest Region. Land Manage. Handb. 24. 89pp.

B.C. Ministry of Forests and B.C. Ministry of Environment, Lands, and Parks. 1995. Forest Practices Code of British Columbia: Biodiversity Guidebook. Victoria, B.C. 99pp.

Buck, S., C. Mullis, and A. Mossman. 1979. Interim report: Corral Bottom - Hayfork Bally fisher study. U.S.D.A. For. Serv. 136pp.

Buskirk, S.W. and R.A. Powell. 1994. Habitat ecology of fishers and American martens. Pages 283-296 in S.W. Buskirk, A.S. Harestad, M.G. Raphael, and R.A. Powell, eds., Martens, sables, and fishers: biology and conservation. Cornell University Press, Ithaca, N.Y. 484pp.

Demarchi, D.A. 1995. Ecoregions of British Columbia, fourth edition. British Columbia Ministry of Environment, Lands and Parks, Victoria, B.C.

Geolgical Survey of Canada. 1988. UTM conversion software. Ottawa, Ontario.

Johnson, S.A. 1984. Home range, movements, and habitat use of fishers in Wisconsin. M.Sc. Thesis, Univ, of Wisconsin, Stevens Point. 78pp.

Jones, J.L. 1991. Habitat use of fisher in northcentral Idaho. M.Sc. Thesis, Univ. Idaho, Moscow. 146pp.

Kelly, G.M. 1977. Fisher (Martes pennanti) biology in the White Mountain National Forest and adjacent areas. Ph.D. Thesis, Univ. Massachusetts, Amherst. 178pp.

Krebs, J. 1993. Wolverine ecology and habitat use in the North Columbia Mountains. Draft Working Plan 1993-1998.

Leonard, R.D. 1980. The winter activity and movements, winter diet, and breeding biology of the fisher (Martes pennanti) in southeastern Manitoba. M.Sc. Thesis, Univ, of Manitoba. 181pp.

Mohr, C.O. 1947. Table of equivalent populations of North American small mammals. Am. Midi. Nat. 37:223-249.

Paragi, T.F. 1990. Reproductive ecology of female fishers in southcentral Maine. M.Sc. Thesis. Univ. Maine, Orono. 107pp.

Powell, R.A. 1977. Hunting behavior, ecological energetics and predator-prey community stability of the fisher (Martes pennanti). Ph.D. Thesis. Univ, of Chicago. 132pp.

_____. 1982. The fisher: natural history, ecology, and behavior. University of Minnesota Press, Minneapolis. 217pp.

Raine, R.M. 1981. Winter food habitas, responses to snow cover and movements of fisher *(Martes pennanti)* and marten *(Martes americana)* in southeastern Manitoba. M.Sc. Thesis, Univ, of Manitoba, Winnipeg. 145pp.

Roy, K.L. 1991, Ecology of reintroduced fishers in the Cabinet Mountains of northwest Montana. M.Sc. Thesis, Univ. Montana, Missoula. 94pp.

Seaman, D.E. and R.A. Powell. 1991. Kernel home range estimation program user's guide. North Carolina State Univ., Raleigh. 5pp.

Strickland, M.A., C.W. Douglas, M.K. Brown, and G.R. Parsons. 1982. Determining the age of fisher from cementum annuli of the teeth. N.Y. Fish Game. J. 29:90-94.

Weir, R.D. 1995. Diet, spatial organization, and habitat relationships of fishers in south-central British Columbia. M.Sc. Thesis, Simon Fraser University, Burnaby, B.C. 138pp.

Zielinski, W.J., G. A. Schmidt, and K.N. Schmidt. 1994. Six Rivers National Forest fisher study: progress report; 10 June 1993 - 27 October 1994. USDA Forest Service, Region 5. unpubl. rep. 20pp.

9.0 APPENDIX

9.1 Appendix 1: Chemical Immobilisation Form

Chemical Immobilisation Form

ID: _____ **Collar Freq:** _____

Date (ddmmyy): _____ **Trapsite:** _____

Trap (circle): Cage Log-cabin **UTM:** _____

Recorders: _____ **Time trap set (hrs):** _____

Ear tags (colour and # of tag): L: _____ R: _____

New / Recapture (circle one) **Tattoo Location:** _____

Hair sample location: _____

Blood sample taken: Yes No Vein: _____

Drug Type	Volume (ml)	Time of Injection	Injection Site

Down Time: _____ Up Time: _____

Time	Body Temp (C)	Respiration Rate (bpm)	Heart Rate (bpm)	CRT

Appendix I (coat.)

Sex (circle one): Female Male **Weight (kg)**: _____

Neck girth (cm): _____ **Chest girth** (cm) _____

Body length (cm): _____ **Tail length** (cm): _____

Head width (cm): _____ **Head depth** (cm) _____

Head circumference (cm): _____

Teeth condition: _____

Tooth removed (circle): PM1 None Other _____

Reproductive status (circle one) Inactive Pre-breeding Active

Photographs (circle as applicable): Roll _____ Photos: _____

Head-front Head-side Body-side Body-ventral

General comments: _____

_____

_____

_____

_____

_____

_____

_____

9.2 Appendix 2: Aerial Telemetry Form

AERIAL TELEMETRY FORM

Form AT _____

DATE (dd/mm/yy) _____ PILOT: _____

OBSERVER: _____ NAVIGATOR: _____

COMMENTS: _____

_____

_____

SPECIES: _____ LOCATION (coordinates) N: _____

E: _____

FREQUENCY: _____

ANIMAL NUMBER: _____ HABITAT TYPE: _____

CANOPY COVER (%): _____

TIME OF LOCATION: _____

COMMENTS:

_____

_____

_____

_____

_____

_____

_____

9.3 Appendix 3: Trap Descriptions

Trap Name	Trap No.	Trap Type[a]	UTM Coordinate		Description of trap location
Finlay 190	1	Havahart - C	406970	6225270	On west side of road about 100m (real) south of 190km board. Entrance to trap is flagged. Trap is 15m from road, just over embankment, under Sx. Door is facing east.
Finlay 188	2	Havahart - P	405080	6226580	On road south from west side of Mesilinka bridge. Trap site is about 300m down road on northwest side of trail, at first corridor of trees. Trap is about 25m from road, tucked under Sx, next to CWD. Door facing northeast
Finlay 188 GUGU	3	Barrel	405080	6226580	N/A
Finlay 187	4	Havahart - C	404700	6227240	On 2nd corner about 300m real west of Mesilinka bridge. Trap is flagged on west side of road, enter through small Ac. Trap is about 20m in, behind large Sx, tucked under smaller Sx and CWD. Door is facing south.
Finlay 185 GUGU	5	Log-cabin	403020	6228860	N/A
Finlay 182	6	Havahart - C	404340	6225550	On east side of road, about 100 m road north of 182km board, at corner of cutblock and culvert trap crossing. Trap is 20 m east of flagging tape, tucked under Bl and next to elevated CWD. Door is facing west.
Finlay 179	7	Havahart - C	402950	6223900	On road heading north into cutblock at 179 dip. Trap is about 1.5 km in, on west side of road, about 200m before end of 1st cutblock. Trap is 5m west of road on edge of Sb bog. Slight hill to east.

a Havahart - C: collapsible Havahart, Havahart - P: permanent Havahart

Appendix 3 (cont.)

Trap Name	Trap No.	Trap Type	UTM Coordinate		Description of trap location
Finlay 179 GUGU	8	Barrel	403640	6223760	On road heading north into cutblock at 179 dip. Trap is about 2 km in, on west side of road, about 40m before road enters 2nd cutblock. Trap is 5m west of road, down embankment, under large Sx. Door facing southeast.
Finlay 177	9	Havahart - C	404440	6222030	On road heading west into cutblock to south of 178km board. Trap is on east side of block, next to Sb bog. Trap is about 50m from road to edge of block, then 30m north of edge. Trap is under Sb, door facing southwest. Flagged.
Finlay 174	10	Havahart - C	405710	6218950	On east side of road at pullout just to road south of 174km board. Trap is down embankment, 30 m from road, under CWD. Door is facing southwest.
Finlay 172	11	Havahart- C	405910	6218470	North side of Omineca bridge. Trap is on east side of road, on edge of embankment just above floodplain of Williston Res. Trap is about 100m from road, flagged with orange tape on bank. Trap under Sx next to CWD, door facing southwest.
Finlay 171	12	Havahart - C	406380	6218090	At wolverine trap site. Trap is about 10m to southwest of wolverine set, under CWD. Door is facing northeast.
Finlay 171 GUGU	13	Log-cabin	406380	6218090	N/A
Finlay 167	14	Havahart - C	410060	6216040	Flagged on northwest side of Finlay FSR about 167, across road from gravel pit (southeast side of road). Trap is in 30m on west side of road, before the small creek which the FSR crosses. Trap is under CWD, next to Pl with door facing north.
Finlay 163	15	Havahart - C	412610	6213390	3m north of wolverine set, under elevated CWD. Door is facing east
Finlay 163 GUGU	16	Log-cabin	412610	6213390	N/A

Appendix 3 (cont.)

Trap Name	Trap No.	Trap Type	UTM Coordinate		Description of trap location
Finlay 161	17	Havahart - C	412610	6213390	At flagging tape, west side of the road, on small (100m) straight stretch to road south of cutblock. Trap is about 25m to west of road, under low canopy of Sx, door facing northeast.
Finlay 156	18	Havahart - C	417750	6209660	At same location as 156 wolverine trap, at creek 150m north of 156km board. Trap is on west side of road, north side of creek. Trap is about 40m in, next to blaze tree (Sx?), tucked next to CWD. Door is facing northwest.
Finlay 156 GUGU	19	Log-cabin	417750	6209660	N/A
Finlay 149 GUGU	20	Log-cabin	422480	6205500	N/A
Finlay 148	21	Havahart - C	421760	6204380	Set on northwest side of road, flagged 75 m north of 148km board. Trap is about 50m in, follow blaze marks on trees. Trap (flagged) is under root mass, door facing southeast. Temperature station on trail to trap (Pl), gauge facing west.
Finlay 148 East	22	Havahart - C	422080	6203380	About 1.5km down haul road that joins Finlay FSR at 148 pullout. Trap is on north side of road, just before cutblock + gully. Trap is in about 15m from road under broken-off Pl. Door is facing south.
Finlay 143 GUGU	23	Log-cabin	421390	6199730	N/A
Finlay 143 Block	24	Havahart - C	420380	6198700	Trap set at southwest corner of cutblock at Finlay 143, where creek enters cutblock. Trap is about 60m from westernmost landing. Trap is on north side of creek, under Bl & Sx. Door is facing east.
S Muscovite Bridge 1	25	Havahart - C	422960	6200260	At first bridge crossing of Strandberg Creek from road at Finlay 143 (6000 Rd.). Trap is on east side of creek embankment, 20m south of road. Trap is under elevated CWD, door facing northwest.

Appendix 3 (cont.)

Trap Name	Trap No.	Trap Type	UTM Coordinate		Description of trap location
S Muscovite Bridge 2	26	Havahart - C	427540	6198620	Second bridge (deactivated) crossing of Strandberg Creek of road from Finlay 143 (6000 Rd.). Trap is on southwest side of creek, 25m south of road. Trap is under large Bl, door facing southeast.
Finlay 137 GUGU	27	Log-cabin	421910	6197390	N/A
Finlay 137	28	Havahart - C	421910	6197390	At wolverine trap at Finlay 137. Trap is located 10m to southwest of wolverine trap, under elevated CWD. Door is facing northwest.
Finlay 121 GUGU	29	Barrel	433580	6182990	N/A
Finlay 121	30	Havahart - P	433540	6182880	About 50m road south of 121 bridge (Eklund Ck). Trap is on west side of road, 40m from road, across clearing. Trap is under CWD next to blaze on tree (Sx?). Door is facing northwest.
Finlay 106 GUGU	31	Log-cabin	442220	6172480	N/A
Finlay 103	32	Havahart - C	445080	6172160	Just south of corner at Finlay 104km. Trap is on southwest side of road, about 35m @ 200 degree, from flag on road. Trap located under CWD, door is facing south.
Finlay 102	33	Havahart - C	445420	6171880	North side of Manson River Bridge, east side of road. Trap is about 40m from pullout, in small grove of small Sx, under CWD. Just past wolverine trap, door facing west.
Finlay 102 GUGU	34	Log-cabin	445420	6171880	N/A
West Main 5	35	Havahart - C	400940	6231560	Trap is on west side of road in Pl stand, to south of forested embankment. Trap is about 10m in, under upturned Pl root mass. Door facing east.
West Main 6.5	36	Log-cabin			N/A

Appendix 3 (cont.)

Trap Name	Trap No.	Trap Type	UTM Coordinate		Description of trap location
West Main 12	37	Havahart - C	396300	6237400	Just north of km 12 West Main. Trap is on east side of clearing (100m north of 12 board). Trap is under CWD, next to Sx & Bl, about 5 m from clearing edge. Door is facing west.
West Main 17 GUGU	38	Log-cabin	392460	6238200	N/A
West Main 17	39	Havahart - C	392450	6238250	Trap to east of corner, about 30m north of wolverine set. Trap is 340 degree, from pink flag. Trap is in about 25m from road, under elevated CWD, door facing northeast. Well hidden.
West Main 19	40	Havahart - C	391750	6240250	At split to old crossing of Mesilinka from the West Main @ km 19. Trap is on east side of road, entrance about 20m south of junction. Trap is about 40m east of flagging, ducked under CWD, door facing south. Flagging at trap.
East Main 5.5	41	Havahart - P	403770	6230900	On road northeast from East Main 5.5 km. Take skid road which goes northwest from 1st switchback. Skid road continues into timber past landing. On west side of road, about 25m along road. Trap is in about 10m, under 2 Sx. Door facing east.
East Main 6	42	Havahart - C	403060	6231160	On big curve @ km 6 on East Main. Trap is on west side of road, down on bench at creek bottom (35 m from road)
East Main 9.5	43	Havahart - C	400675	6233050	On 1st creek to south of Gopherhole Creek. Trap is on west side of road, south side of creek, under Sx and next to CWD about 20 m from road.
East Main 11.5	44	Havahart - C	399275	6234575	On west road crossing Gopherhole Creek. Trap is on northeast side of road just before culvert removal and road deactivation. Trap is 30 m in on side hill, door facing road

Appendix 3 (cont.)

Trap Name	Trap No.	Trap Type	UTM Coordinate		Description of trap location
East Main 13	45	Havahart - C	399400	6236150	Trap to west of junction at 13km. Trap is under root mass/CWD about 15m from flagging tape at road. Door is facing east.
Manson Peninsula 7.5	46	Havahart - C	448500	6184000	About 150m up road going west from junction at 8km on Manson Peninsula FSR. Trap is flagged on north side of road, about 50m before 1st landing. Trap is about 10m in from road, door facing south.
Manson Peninsula 8	47	Havahart - C	448650	6184320	About 200m past 8km board Manson Peninsula FSR. Trap is on east side of road, about 30m in, tucked under fallen At. Door is facing west.
Mesilinka Camp	48	Havahart - C	412680	6218840	On upper crest of creek gully to north of trailer court at Mesilinka Camp. Trap is about 10m towards creek from road next to Pl, about 20m west of propane tanks. Door is facing south. Temperature station - gauge facing north on Pl.
Chunamon 6	49	Havahart - P	415940	6216540	Trap is on north side of road, just road south of 6km board (corner). Trap is down steep embankment, about 20m from road. Trap is located in small patch of Sx, about 3m from beaver dam/creek. Door is facing northwest.
Chunamon 8.5	50	Havahart - P	417250	6218130	Flagged from about 8.5km. Trap is on northwest side of cutblock about 80m from road. Trail flagged. Trap is near large Ac and located under 2 large Sx, door facing northwest.
Chunamon 10	51	Havahart - C	417920	6218890	On northwest side of road 75m road south of 10km board. In about 30m, under Sx CWD, door facing northeast. Flagged.

Appendix 3 (cont.)

Trap Name	Trap No.	Trap Type	UTM Coordinate		Description of trap location
Chunamon 13	52	Havahart - P	418910	6220040	About 70m north of 13km, 40m north of junction with Raspberry Road. Trap is on west side of road, south of junction with 31 road and creek crossing. Trap is about 10m from right-of-way, under small Sx next to Ep CWD. Door is facing east.
Chunamon 16	53	Havahart - P	418330	6222760	Flagged on creek 75m north of 16km board. Trap is on east side of road, just south of small creek. Trap is 20m from road, tucked in small covey of Ep/Sx. Door is facing north.
Chunamon 24 GUGU	54	Log-cabin	414050	6230180	N/A
Chunamon 36 GUGU	55	Log-cabin	413080	6233190	N/A
Chunamon 43 GUGU	56	Log-cabin	408780	6240230	N/A
Chunamon 52 GUGU	57	Log-cabin	405200	6251130	N/A
Finlay 209	58	Havahart - C	419340	6218910	Trap is in southwest corner of block real east of 209km board (west of junction with Raspberry road). Trap is located about 10m from cutblock edge under suspended PI CWD. Trap is about 20m north of hygric area at very corner. Door is facing south.
Raspberry Harbour Junc.	59	Havahart - C	422720	6215830	Trap site (flagged) is about 200m from junction with Raspberry Road, towards Raspberry Harbour, but before wetland on east side of road. Trap is about 20m to northwest of road, under first covey of Sx, next to CWD. Door is facing south.
Raspberry Airstrip	60	Havahart - C	424100	6213850	South end of Raspberry Airstrip. Trap is about 100m north of the south east corner of clearing/regen. Trap is located about 10m in from forest edge, under small group of Sb. Door is facing east.

Appendix 3 (cont.)

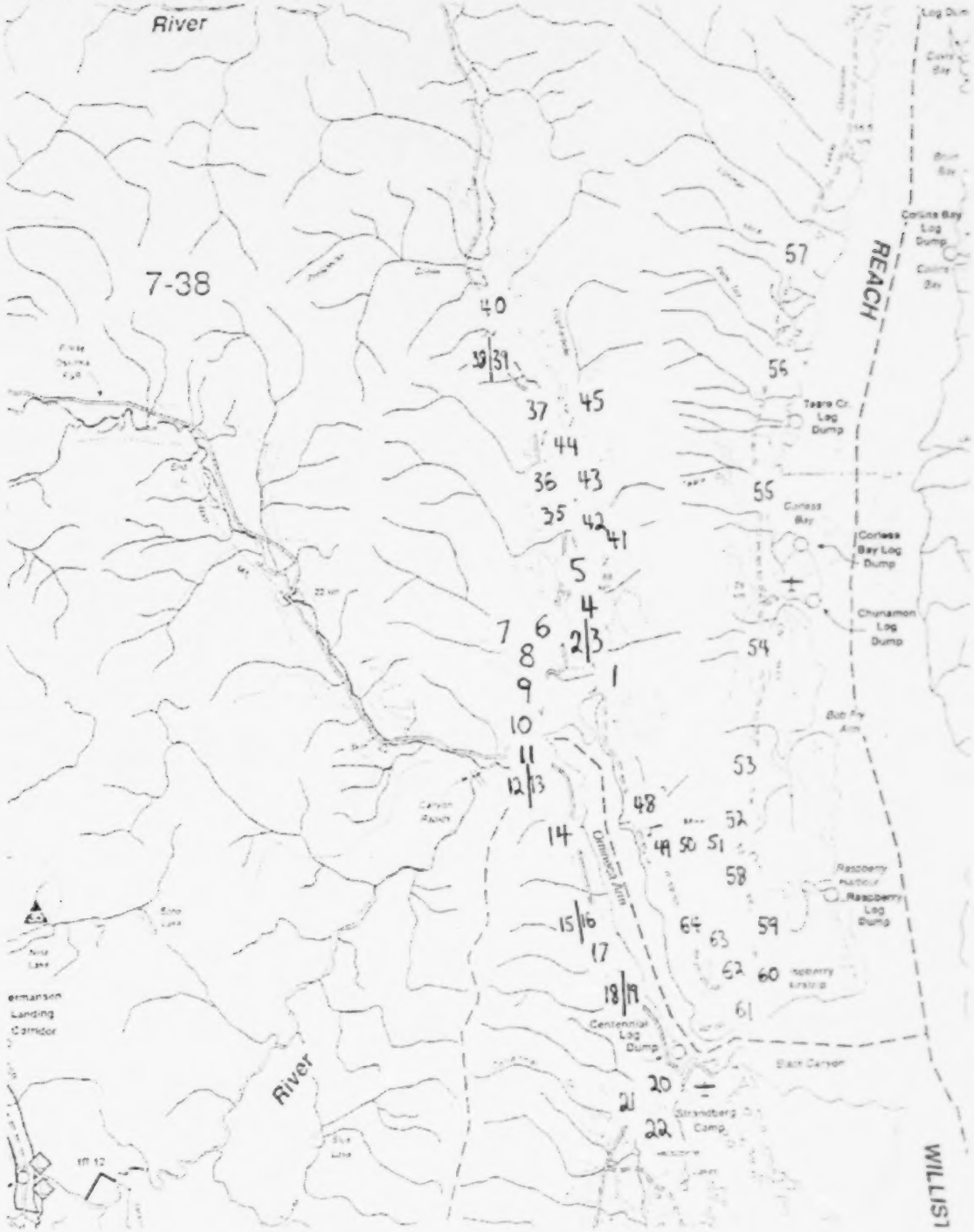
Trap Name	Trap No.	Trap Type	UTM Coordinate		Description of trap location
Raspberry Pt. 2.5	61	Havahart - P	424090	6210820	On road to ice bridge crossing, about 500m road west of 2km. Trap is on east side of road, about 20 m east of flagging tape. Trap is under CWD/root mass, door facing east.
Ice Bridge 0.5	62	Havahart - P	422340	6212320	Up northwest skid road 500m on Ice Bridge road from its junction with Raspberry road. Trap is in east corner of uncut stand at end of skid road. Trap is set 15m in on south side of skid road heading into stand. Trap under CWD, door facing east.
Ice Bridge 4.5	63	Havahart - C	419690	6214130	On road heading north from Ice Bridge 4.5km. Follow road to landing, then continue to forest edge (about 100m). Trap is on northeast side of small creek from cutblock. Trap is about 10m in from cutblock edge, under Bl & elevated CWD, door facing west.
Ice Bridge 6	64	Havahart - C	419190	6213870	Trap is at 230 degr. from yellow flag on west side of road at 6km board. Trap is 10m from edge of landing, under Bl. Trap is under elevated CWD, door facing northwest.
Manson 8	65	Havahart - C	438370	6167720	Trap is on north side of road, by creek to the east of the cutblock. Trap is on east side of creek, about 30m from the road. Trap is deep under elevated CWD, door facing east
Manson 9.8 GUGU	66	Barrel	436750	6167590	N/A
Manson 26 GUGU	67	Log-cabin	432080	6156180	N/A
Manson 26	68	Havahart - C	432080	6156180	N/A
Skunk Bridge GUGU	69	Barrel	426910	6155650	N/A
Lower Donna Ck GUGU	70	Log-cabin	424670	6161230	N/A
Manson 43	71	Havahart - C	417125	6160000	N/A

Appendix 3 (cont.)

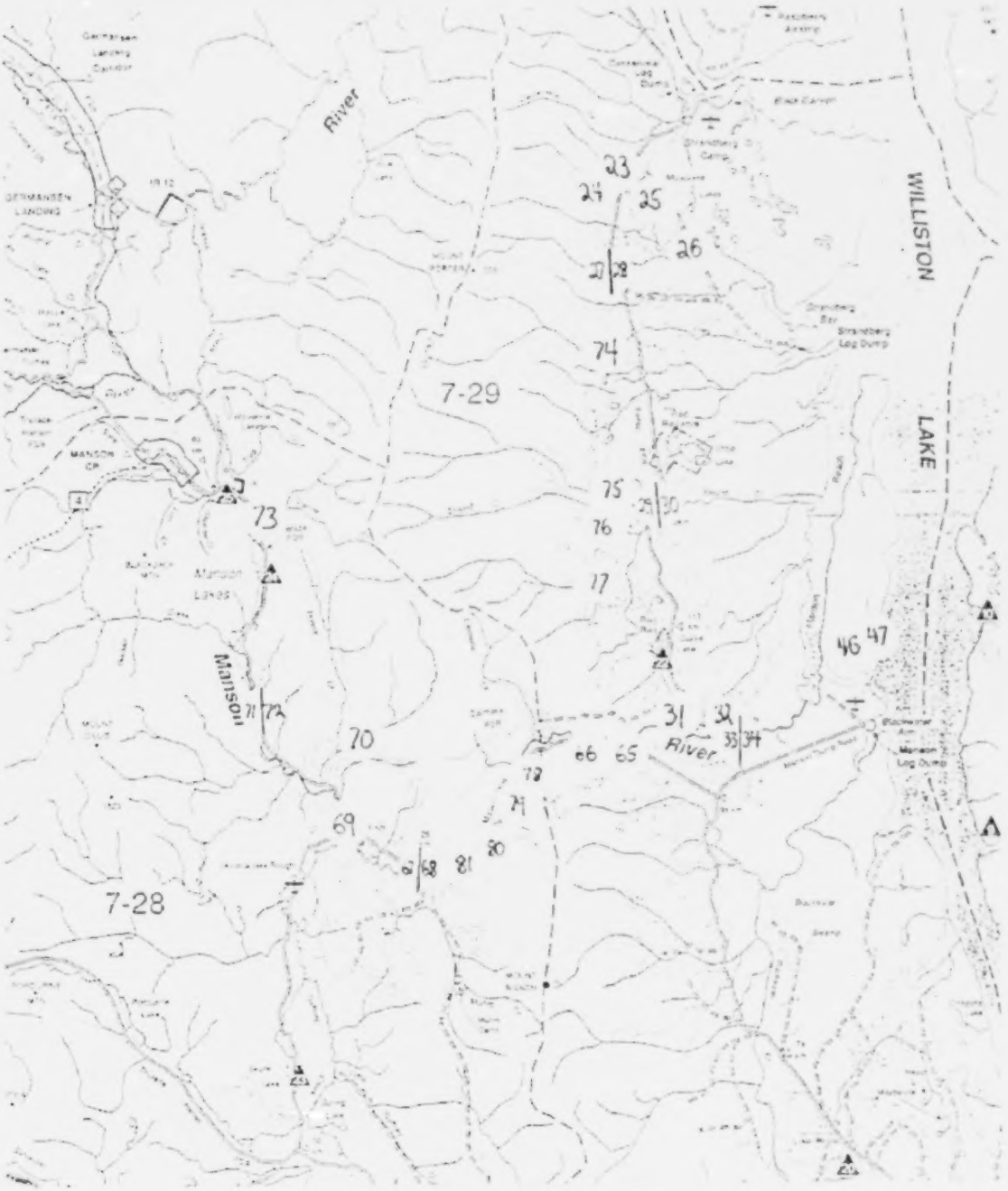
Trap Name	Trap No.	Trap Type	UTM Coordinate		Description of trap location
Manson 43 GUGU	72	Log-cabin	417125	6160000	N/A
Granite Creek GUGU	73	Log-cabin	411770	6170080	N/A
Fries Creek GUGU	74	Log-cabin	425890	6190560	N/A
47000-NORTH	75	Havahart - C	431680	6181850	On portion of 47000 road that crosses Eklund Ck, about 80m before bridge out. Trap is on west side of road, about 25m up a gully from large cottonwood and blue flagging tape. Trap is under elevated CWD, door facing east.
47000-SOUTH	76	Havahart - C	430360	6180750	At bottom of hill, just before block 310-310 (silvic. plan map) on 47000 road. Trap is on southeast side of road, just before clearing. Trap is in 30m, under CWD. 2 blaze trees mark way in from flagging tape. Door is facing west
Meadow Creek GUGU	77	Log-cabin	432400	6177400	N/A
Manson 15 GUGU	78	Log-cabin	434700	6162380	N/A
Manson 16	79	Havahart - C	434870	6161170	N/A
Manson 20	80	Havahart - C	434870	6159730	N/A
Manson 21.6 GUGU	81	Log-cabin	434280	6158600	N/A

9.4 Appendix 4: Trapline Locations

9.4.1 North study area trap locations



9.4.2 South study are trap locations



9.5 Appendix 5: Capture Data

Name	ID number	Collar Freq.	Date	Trap Site	Trap type	Recorder	Duration trapped	Ear tag - Left	Ear tag - Right	New/ Recap
PATCHES	F02	148.132	18/11/96	FINLAY 102	HAVAHART	RW, TB	27.5	YELLOW	BLUE	NEW
CALI	F04	148.102	28/11/96	MANSON 15	LOG CABIN	VH, ERIN	29.8	YELLOW	YELLOW	NEW
BEAU	F01	148.060	4/2/97	FINLAY 156	LOG CABIN	VH, TB	23	BLUE	*	RECAP
SOLO	F05	148.145	13/2/97	MEADOW CK	LOG CABIN	VH	30	GREEN	RED	NEW
HADEN	F08	148.041	14/2/97	LOWER DONNA CK	LOG CABIN	VH, CH	27	GREEN	YELLOW	NEW
INKA	F07	148.113	21/2/97	FINLAY 106	LOG CABIN	VH, CH		*	GREEN	RECAP
FRASER	F30	148.573	22/2/97	TENAKIHI 17.5	LOG CABIN	RW, TB	23	GREEN	B-XXXXX	NEW
AMELIA	F03	148.162	24/2/97	WEST MAIN KM 12	HAVAHART	RW, TB	23.6	YELLOW	GREEN	NEW
OLSIE	F09	148.183	7/3/97	S. MUSCOVITE 2	HAVAHART	TB, JS	22	BLUE	RED	NEW
FRANKIE	F15	148.312	13/4/97	OSILINKA 15	LOG CABIN	VH, VOL	24	n/a	n/a	NEW

* unknown - missing tag with scarring evident in pinnae of ear

Appendix 5 (cont.)

				1st drug administration				2nd drug administration			
Name	**Tattoo location**	**Hair sample location**	**Blood samples**	**Drug Type**	**Volume**	**Time of injection**	**Injection site**	**Drug Type**	**Volume**	**Time of injection**	**Injection site**
PATCHES	RIGHT INGUINAL	HEAD	NO	KETAMINE-ROMPUN	0.35	14:20	LEFT HIND				
CALI	RIGHT INGUINAL	HEAD	NO	TELAZOL	0.55	16:46	RIGHT HIND				
BEAU	LEFT INGUINAL	HEAD	NO	KETAMINE-ROMPUN	0.45	15:40	RIGHT HIND	KETAMINE-ROMPUN	0.25	15:59	MISS
SOLO	NONE?	NO	NO	TELAZOL	0.5	20:23					
HADEN	RIGHT INGUINAL	HEAD	NO	TELAZOL	0.5	17:53	LEFT HIND				
INKA			NO	TELAZOL	0.6	15:24					
FRASER	RIGHT INGUINAL	HEAD	NO	TELAZOL	0.9	14:53	LEFT HIND	KETAMINE	0.3	15:26	LEFT HIND
AMELIA	LEFT INGUINAL	HEAD	NO	TELAZOL	0.52	15:47	LEFT HIND				
OLSIE	RIGHT INGUINAL	HEAD	NO	TELAZOL	0.3	14:57	RIGHT HIND				
FRANKIE	LEFT INGUINAL	HEAD	NO	TELAZOL	0.25	14:35	LEFT HIND				

Appendix 5 (cont.)

Name	3rd drug administration							Physiological measures 1				
	Drug Type	Volume	Time of injection	Injection site	Drug dosage (mg/kg)	Down time	Up time	Time	Body temp	Resp. rate	Heart rate	CRT
PATCHES					14.0	14:23	15:28					
CALI					22.4	16:49			40.0			
BEAU	KETAMINE-ROMPUN	0.25	16:00	RIGHT HIND	13.9	15:43	16:15	15:50				
SOLO					14.3				38.3			
HADEN					8.6	17:56						
INKA					20.7	15:26						
FRASER					20.0	.4:56	15:35	15:06				
AMELIA					17.3	15:50	18:00	16:05	38.6	28		GOOD
OLSIE					10.7	15:00		15:12	38.6	60	112	GOOD
FRANKIE					9.1	14:40	15:10		37.1			

Appendix 5 (cont.)

Name	Physiological measures 2					Physiological measures 3					Sex	Weight	Neck girth	Chest girth	Body length
	Time	Body temp	Resp. rate	Heart rate	CRT	Time	Body temp	Resp. rate	Heart rate	CRT					
PATCHES		37.5					36.4				F	2.5		25	58
CALI											F	2.45		21	56
BEAU	15:52	38.3				16:02	37.6				M	5.05	23	31	68.5
SOLO											F	3.5	17.8	25.5	67.8
HADEN											M	5.8	24.2	30.5	70.8
INKA											F	2.9	17.8	23.5	61.8
FRASER	15:15	38.8			GOOD						M	4.5	24	30	70
AMELIA	16:30	38.7	36		GOOD	16:50		36			F	3	17	22	58
OLSIE	15:25	36.8				15:35	35.9	40			F	2.8	17	21.3	59.6
FRANKIE											F	2.75	18	24.3	55.7

Appendix 5 (cont.)

Name	Tail length	Head width	Head depth	Head circ.	Teeth condition	Tooth removed[a]	Reproductive status	Photographs
PATCHES	37	6.2			BLACKENED UPPER CANINES	NO	INACTIVE	HEAD-FRONT
CALI	34	7	6	19.5	URC- CHIP; LI - MOD. WEAR; UI - NO WEAR	PM1	INACTIVE	HEAD-FRONT, HEAD-SIDE, BODY-SIDE, BODY- VENTRAL
BEAU	39.5	6.58	7.37	26.5	EXCELLENT	NO	INACTIVE	HEAD-FRONT, HEAD-SIDE, BODY-SIDE, BODY- VENTRAL
SOLO	36.5			19.5	GOOD	NO		HEAD-FRONT, HEAD-SIDE, BODY-SIDE, BODY- VENTRAL
HADEN	38.4			30.1	EXCELLENT	NO	INACTIVE	HEAD-FRONT, HEAD-SIDE, BODY-SIDE, BODY- VENTRAL
INKA	38.2				??C - BROKEN; LI - WORN	NO		HEAD-FRONT, HEAD-SIDE, BODY-SIDE, BODY- VENTRAL
FRASER	37	8.9	6.5	27	ULC- CHIP;GUMS SLIGHT BLACKENING	NO	INACTIVE	HEAD-FRONT, HEAD-SIDE, BODY-SIDE, BODY- VENTRAL
AMELIA	32	6.1	5.3	19.1	EXCELLENT, LIKELY JUVENILE	YES	INACTIVE	HEAD-FRONT, HEAD-SIDE, BODY-SIDE, BODY- VENTRAL
OLSIE	34.3	5.7	4.5	22	EXCELLENT	PM1	PRE-BREEDING	HEAD-FRONT, HEAD-SIDE, BODY-SIDE, BODY- VENTRAL
FRANKIE	35.9	6.5	5.9	21	UC-BROKEN/YELLOW, LLC BROKEN TIP, LI WORN	NO	PREGNANT	

PM1 - premolar 1, YES - tooth removed but no root, NO - no tooth removed

Appendix 5 (cont.)

Name	General comments
PATCHES	Ambient -17 C. Body temp dropped rapidly (~13 min) from 40 C to 36.4 C. Started shivering at about 19 min. Tried applying hot-shots (not work). Wrapped fisher in jackets. Fairly shallow anaesthesia - bitten during tooth extraction.
CALI	
BEAU	
SOLO	ALL TOES, NO BROKEN TEETH, NO SCARS
HADEN	ERDO QUILLS - HEAD & VENTRAL
INKA	Recap from winter 1996, one eartag missing in scarred left ear
FRASER	calcareous build-up on right mandible, scar along saggital crest and right front foot, worn spots on front elbows (pitch?) Might be old or incomplete hit of Telazol
AMELIA	Likely juvenile - relatively unworn teeth, claws slightly shredded, otherwise good health
OLSIE	Nipples partly worn, temp dropped, ambient -3/-11 @ 148
FRANKIE	feet and toes intact, no apparent wounds/injuries, appears older, no black staining on gums, nipples swollen, may be pregnant?

9.6 Appendix 6: Aerial Telemetry Data

Appendix 9.6.1 Aerial locations

Date	Pilot[a]	Observer[b]	Navigator[c]	Ceiling[d] (m)	Precip.	Temp. (C)	Comments	Latitude	Longitude	Frequency (MHz)	ID
21/11/96	LF		VH					55 43.60	123 49.80	148.132	F02
27/11/96	LF		VH					55 41.41	123 53.57	148.132	F02
04/12/96	LF		VH					55 37.38	124 02.77	148.102	F04
12/12/96	LF		RW							148.132	F02
12/12/96	LF		RW							148.102	F04
22/01/97	LF		VH	2000	l. snow	-10		55 41.59	123 51.89	148.132	F02
22/01/97	LF		VH	2000	l. snow	-10		55 32.75	124 03.98	148.102	F04
05/02/97	LF		VH	CAVU	0	-8		56 00.53	124 17.24	148.060	F01
05/02/97	LF		VH	CAVU	0	-8		55 44.79	123 49.01	148.132	F02
05/02/97	LF		VH	CAVU	0	-8		55 32.32	124 05.20	148.102	F03
13/02/97	LF		VH					55 59.22	124 08.82	148.060	F01
13/02/97	LF		VH	mix cloud	0	-8		55 41.69	123 52.01	148.132	F02
13/02/97	LF		VH					55 33.00	124 10.71	148.102	F04
19/02/97	LF	RB	ECL	CAVU	0	-2		56 00.10	124 12.35	148.060	F01
19/02/97	LF	RB	ECL	CAVU	0	-2		55 41.95	123 52.04	148.132	F02
19/02/97	LF	RB	ECL	CAVU	0	-2		55 38.98	124 01.09	148.102	F04
19/02/97	LF			CAVU	0	-2		55 46.50	124 05.00	148.145	F05
27/02/97	LF		RW	CAVU	0	-5	NO GPS			148.060	F01
27/02/97	LF		RW	CAVU	0	-5	NO GPS			148.132	F02
27/02/97	LF		RW	CAVU	0	-5		56 16.72	124 44.04	148.162	F03
27/02/97	LF		RW	CAVU	0	-5	NO GPS			148.102	F04
27/02/97	LF		RW	CAVU	0	-5	NO GPS			148.113	F07

a LF - Larry Frey, Eric - Eric ?

b RB - Robert Busch, BH - Bruce Harrison, DS - Dave Stuart, HD - Helen Davis, CJ - Chris Johnson, JQ - James Quayle

c RW - Richard Weir, ECL7EL - Eric Lofroth, VH - Virgil Hawkes, CH - Corrina Hootikoff, LF - Larry Frey

d CAVU - clear above visibility unlimited, all others metres above sea level

Appendix 6.1 (cont.)

Date	Pilot	Observer	Navigator	Ceiling (m)	Precip.	Temp. (C)	Comments	Latitude	Longitude	Frequency (MHz)	ID
27/02/97	LF		RW	CAVU	0	-5		56 18.48	125 18.62	148.573	F30
07/03/97	LF	BH	RW	2000	l. snow	-5		56 14.52	124 39.62	148.162	F03
17/03/97	LF		RW	2500		-15		55 41.92	123 51.78	148.132	F02
17/03/97	LF		RW	2500		-15		56 14.67	124 36.07	148.162	F03
17/03/97	LF		RW	2500		-15		55 39.10	124 00.80	148.102	F04
17/03/97	LF		RW	2500		-15		55 47.73	124 04.31	148.145	F05
17/03/97	LF		RW	2500		-15		55 40.99	123 55.50	148.113	F07
17/03/97	LF		RW	2500		-15		55 57.03	124 05.34	148.182	F09
19/03/97	LF	DS	CH					55 57.30	124 12.07	148.060	F01
26/03/97	LF	CH	EL			-1		55 58.88	124 08.66	148.060	F01
26/03/97	LF	CH	EL			-1		55 43.41	123 50.42	148.132	F02
26/03/97	LF	CH	EL			-1		56 16.70	124 41.77	148.162	F03
26/03/97	LF	CH	EL			-1		55 40.55	123 27.30	148.113	F07
26/03/97	LF	CH	EL			-1		55 56.26	124 08.53	148.183	F09
26/03/97	LF	CH	EL			-1		56 23.99	125 04.87	148.573	F30
02/04/97	LF	HD	RW					55 43.71	123 49.04	148.132	F02
02/04/97	LF	HD	RW					56 16.20	124 39.94	148.162	F03
02/04/97	LF	HD	RW							148.102	F04
02/04/97	LF	HD	RW					55 44.86	124 04.65	148.145	F05
02/04/97	LF	HD	RW					55 40.33	123 57.19	148.113	F07
02/04/97	LF	HD	RW					55 55.88	124 09.36	148.182	F09
04/04/97	LF		LF					55 49.46	124 03.57	148.060	F01
04/04/97	LF		LF					55 56.11	124 09.32	148.183	F09
08/04/97	LF	HD	RW	CAVU	0	2		56 13.39	124 34.75	148.162	F03
08/04/97	LF	HD	RW	CAVU	0	2		55 47.36	124 04.77	148.145	F05
08/04/97	LF	HD	RW	CAVU	0	2		55 40.33	123 57.19	148.113	F07
08/04/97	LF	HD	RW	CAVU	0	2		55 55.88	124 09.36	148.182	F09
16/04/97	LF	CJ	EL	1600	trace	7		55 43.75	12349.43	148.132	F02
16/04/97	LF	CJ	EL	1600	trace	4		56 16.23	124 42.30	148.162	F03
16/04/97	LF	CJ	EL	1600	trace	5		55 39.08	124 00.71	148.102	F04

Appendix 6.1 (cont.)

Date	Pilot	Observer	Navigator	Ceiling (m)	Precip.	Temp. (C)	Comments	Latitude	Longitude	Frequency (MHz)	ID
16/04/97	LF	CJ	EL	1600	trace	8		55 47.95	124 06.68	148.145	F05
16/04/97	LF	CJ	EL	1600	trace	6		55 40.47	123 56.90	148.113	F07
17/04/97	LF		LF	1800	0	-4		55 59.11	124 05.13	148.060	F01
17/04/97	LF		LF	1800	0	-4		55 56.01	124 09.31	148.183	F09
17/04/97	LF		LF	1800	0	-4		56 06.45	124 43.01	148.312	F16
18/04/97	LF		EL	CAVU	0	2		56 00.06	124 10.52	148.060	F01
18/04/97	LF		EL	CAVU	0	2		5542.17	124 51.05	148.132	F02
18/04/97	LF		EL	CAVU	0	2		56 16.64	124 42.30	148.162	F03
18/04/97	LF		EL	CAVU	0	2		55 47.75	124 04.06	148.145	F05
18/04/97	LF		EL	CAVU	0	2		55 41.84	123 56.67	148.113	F07
18/04/97	LF		EL	CAVU	0	2		55 57.37	124 08.53	148.183	F09
18/04/97	LF		EL	CAVU	0	2		56 06.61	124 42.89	148.312	F16
19/04/97	LF		GM	2000	0	-2		55 57.65	124 09.03	148.060	F01
19/04/97	LF		GM	2000	0	-2		55 43.68	123 49.23	148.132	F02
19/04/97	LF		GM	2000	0	-2		56 16.62	124 42.26	148.162	F03
19/04/97	LF		GM	2000	0	-2		55 44.68	124 02.41	148.145	F05
19/04/97	LF		GM	2000	0	-2		55 40.45	123 57.20	148.113	F07
19/04/97	LF		GM	2000	0	-2		55 58.88	124 09.59	148.183	F09
19/04/97	LF		GM	2000	0	-2		56 06.23	124 43.07	148.312	F16
23/04/97	Eric		TB					56 16.62	124 42.26	148.162	F03
23/04/97	Eric		TB					56 06.23	124 43.07	148.312	F16
23/04/97	Eric		GM					55 57.27	124 07.75	148.183	F09
23/04/97	Eric		GM					55 46.66	124 01.27	148.145	F05
23/04/97	Eric		GM					55 43.92	123 49.05	148.132	F02
24/04/97	LF	JQ	CH		rain	2		56 06.17	124 10.29	148.060	F01
24/04/97	LF	JQ	CH		rain	2		55 43.65	123 49.44	148.132	F02
24/04/97	LF	JQ	CH		rain	2		56 16.57	12441.91	148.162	F03
24/04/97	LF	JQ	CH		rain	2		55 38.82	124 02.09	148.102	F04
24/04/97	LF	JQ	CH		rain	2		55 48.36	124 05.27	148.145	F05
24/04/97	LF	JQ	CH		rain	2		55 40.24	123 55.92	148.113	F07

Appendix 6.1 (cont.)

Date	Pilot	Observer	Navigator	Ceiling (m)	Precip.	Temp. (C)	Comments	Latitude	Longitude	Frequency (MHz)	ID
24/04/97	LF	JQ	CH		rain	2		55 57.36	124 08.33	148.183	F09
24/04/97	LF	JQ	CH		rain	2		56 03.80	12440.31	148.132	F16
04/05/97	LF		LF	clear	0	0		55 52.79	124 14.61	148.060	F01
04/05/97	LF		LF	clear	0	0		55 43.78	123 49.50	148.132	F02
04/05/97	LF		LF	clear	0	0		56 16.65	124 24.36	148.162	F03
04/05/97	LF		LF	clear	0	0		55 39.25	124 00.75	148.102	F04
04/05/97	LF		LF	clear	0	0		55 44.95	124 05.22	148.145	F05
04/05/97	LF		LF	clear	0	0		55 40.45	123 57.44	148.113	F07
04/05/97	LF		LF	clear	0	0		55 58.42	124 02.67	148.183	F09
04/05/97	LF		LF	clear	0	0		56 06.48	124 39.57	148.312	F16

Appendix 6.2 - Descriptions of aerial locations

Date	ID	Habitat[e]	Canopy Cover (%)	Time	Comments
21/11/96	F02	RIP			in riparian zone - might be in large Ac
27/11/96	F02	Sx/Ac			
04/12/96	F04	Sx/Salix			
12/12/96	F02	Ac/Sx Flp	20	10:10	
12/12/96	F04	Sx/Pi		10:25	
22/01/97	F02	RIP Sx	40	14:00	In trap at Finlay FSR 102?
22/01/97	F04	RIP	0	14:20	Manson 26 & 16000 Rd in middle of "old" clearcut near Munro Creek. In pile of CWD surrounded by willow saplings
05/02/97	F01	Sx/Pl	30	12:43	
05/02/97	F02	Sx/At		12:26	VISUAL - Running for cover on Manson Peninsula E side of Blackwater arm
05/02/97	F03	Sx	30	11:39	S. side of Manson River (about 26.5km) in spruce right next to river bank. Released from Manson 26 a few hours earlier
13/02/97	F01	Sx/Pl		12:00	VISUAL - Muscovite lakes, fringe of Sx/Pl on south side of very small pond, lots of deciduous, eating something on ground
13/02/97	F02	Sx/Ac		12:00	On south side of Manson River, 25m from shore, 0.5 km downstream of bridge
13/02/97	F04	Pi/At		12:00	Pine with few aspen between river and road on north side of river.
19/02/97	F01	Sx/At	30	16:00	Muscovite Lakes - small bush at end of lake. On small flat of spruce @ end of lake; rest of area is steep pine aspen
19/02/97	F02	Sx/Ac RIP	20	15:30	East of km 104 corner open stand, lots of windfall
19/02/97	F04	Sx/Ac RIP	40	15:20	Manson River floodplain cutblock of 11 km corner Manson FSR, at north end of patch of timber at river's edge
19/02/97	F05			17:20	
27/02/97	F01	Pi/Sx	40	12:30	
27/02/97	F02	RIP Sx/Ac	20	12:50	

e Sx - *Picea glauca* x *engelmannii*, Sb - *Picea mariana*, Sw - *Picea glauca*, Pl - *Pinus contorta*, At - *Populus tremuloides*, Ac - *Populus balsamifera*, Ep - *Betula papyrifera*, RIP/Rip - riparian, Salix - *Salix* spp., FLP/floodpl - floodplain, CC - clearcut

Appendix 6.2 (cont.)

Date	ID	Habitat	Canopy Cover	Time	Comments
27/02/97	F07	RIP Pl/Sx/Ac	40	12:55	On edge of Manson River, south of pull out on Carmella Ck road
27/02/97	F30	Sb/Sx/Pl	20	10:15	Hunting on edge of Sb swamp with Sx and Pl. Adjacent Pl stand downslope, toward Tenakihi M/L
07/03/97	F03	Pi/Sx	40	14:25	On hillside, just upslope from Mesilinka River
17/03/97	F02	Ac/Sx	10	10:35	In large Ac? on bend in Manson, just downstream of Finlay 102 bridge
17/03/97	F03	Pi/Sx	30	9:15	Up slope from creek to south of Gopherhole Creek, on edge of clearcut
17/03/97	F04	Sx/Ac	30	12:20	On Manson River (about 12km?) on north side of river.
17/03/97	F05	Sx/Ac	20	9:45	Double beeping. About 100m upstream from creek that crosses the road just to north of Finlay 121 bridge
17/03/97	F07	Ac floodpl	20	10:00	In large Ac?
17/03/97	F09	CC	30	11:00	Bounding from slashpile to slashpile (tracks). In patch of small Pl at location.
19/03/97	F01	Sx/At			Mature spruce with aspen, Muscovite Lakes
26/03/97	F01	Sx/Ep	40	15:30	Muscovite Lakes, bank side of lake, amongst Sx/Ep stand. Can see tracks on the ice around water openings in ice
26/03/97	F02	Sb	5	14:45	Upstream from Manson River mouth, swampy area along FLP in patch of black spruce
26/03/97	F03	Sx/Ac RIP	20	11:23	Mesilinka River FLP on island east side of river, across from ~15km West Main. Open canopy, medium sized cottonwoods
26/03/97	F07	Ac/Sx RIP	25	14:38	Along Manson River across from 106 Finlay, flat opening, FLP
26/03/97	F09	Pi/At	60	15:20	south end of Muscovite Lakes, riparian area in Pi/At stand with Sx along edges and few Ep
26/03/97	F30	Sx RIP	30	11:42	MORTALITY - riparian Sx, east side of river @ base of slope, lots of tracks (moose, caribou?), drainage west of Carina Lakes
02/04/97	F02	Ac FLP			
02/04/97	F03	Sx	40	13:45	km 12 on the West Main
02/04/97	F04	Ac		11:50	Den
02/04/97	F05	Sx RIP		14:21	

Appendix 6.2 (cont.)

Date	ID	Habitat	Canopy Cover	Time	Comments
02/04/97	F07	Ac/Sx		11:35	Den.
02/04/97	F09	CC		12:55	In Ac in clearcut (den)
04/04/97	F01	LAKE	0		VISUAL - On ice of Shoal Lake, checking out muskrat pushup (??)
04/04/97	F09	CC	5		Same location as 02/04/97
08/04/97	F03	Pl/Sx/At	30	8:55	
08/04/97	F05	Pl	30	13:30	
08/04/97	F07	Ac/Sx		12:30	In den.
08/04/97	F09	CC		13:00	In her den.
16/04/97	F02	Ac	10	16:31	Patch of large cottonwoods on south side of Manson where it breaks into delta
16/04/97	F03	Sb/Ac	16	14:39	East side of Mesilinka River in riparian area on point in river just north of oxbow were previously located
16/04/97	F04	Ac/Sx		16:16	In den
16/04/97	F05	Sx/At	40	17:00	North of north fork of Eklund creek
16/04/97	F07	Sx/Ac	30	16:21	near den site
17/04/97	F01	Sx/At	50	15:40	In fringe of spruce around small pine surrounded by aspen - Muscovite lakes. Shift to 148.061
17/04/97	F09	CC	5	15:35	In den
17/04/97	F16	Sx/Ac		13:15	North side of Osilinka River spruce and cottonwood, across river from cutbank
18/04/97	F01	At/Sx	5	16:11	On edge of lake under spruce (only 3 of them) 1.5 km south of Omineca Arm
18/04/97	F02	CC/Ac	5	15:02	In Ac (??) between 101 gravel pit and Manson in bunch of big Ac
18/04/97	F03	Sx/At RIP	35	10:00	In same area as 16/04/97
18/04/97	F05	Sx/Pl	45	15:20	250m west of FFSR at 122 km corner. In patch of spruce amidst seas of pine.
18/04/97	F07	Sx/At/Ac	20	15:37	Open spruce/balsam poplar/aspen rise between 35000 rd and 103 swamp. Very close to Marley (GUGU)
18/04/97	F09	Ac/Ep/Sx	5	16:00	Aspen/birch/spruce near confluence of 3 lakes in Muscovite. 3 km north of den site

Appendix 6.2 (cont.)

Date	ID	Habitat	Canopy Cover	Time	Comments
18/04/97	F16	Sx/Ac	45	12:34	North side of Osilinka river on flat, about 10m in from gravel bar, across from cutblock @15km
19/04/97	F01	At/Sx	25	15:00	Open stand along lake edge. Rises to 2 small hills with primarily aspen cover. Scattered spruce intermixed. Muscovite lakes area.
19/04/97	F02	Sx/Salix		13:40	Edge of Sx/willow near cottonwood stand, open point of river.
19/04/97	F03	Ac/Sx	35	9:05	Same place as before, perhaps denned
19/04/97	F05	Pi/Sx	50	14:40	Fairly thick stand of PI and Sx just above a gully, Meadow Ck area. Sx succession well advanced, beginning to dominate stand, although still more PI
19/04/97	F07			13:45	In den
19/04/97	F09			14:50	In den
19/04/97	F16	Ac/Sw		11:15	In den
23/04/97	F03			9:15	In den
23/04/97	F16			11:15	In den
23/04/97	F09	At	25	12:45	Open aspen stand in Muscovite Lakes area, raised mound with At surrounded by Sx/PI forest near small lake
23/04/97	F05	PI	30	12:55	Open regenerating PI stand of old cutblock in Eklund creek area small stand of 3-4 m high PI along logging road through cutblock.
23/04/97	F02	Ac	10		Very open Ac stand in FLP of river.
24/04/97	F01	Sx	40	15:45	near muscovite Lakes in an isolated depression of spruce amongst a plateau of Ep next to small lake
24/04/97	F02	Sx/Ac	5	14:00	Manson FLP on south side (point bar). Very open and patchy habitat of Ac, young Sx, and clumps of Salix
24/04/97	F03	Sx/Ac	35	10:30	Cottonwood FLP area, same area as 18/04/97, maybe den.
24/04/97	F04	Sx/Ac	65	13:47	Near Manson River on floodplain, near 12 km on Manson FSR
24/04/97	F05	PI/Sx/Ep	40	15:15	Small patch of birch within pine and spruce matrix. Area north of Eklund creek, west of road
24/04/97	F07	cc	5	13:55	VISUAL - south of Manson River, traveling from pile of old logs toward Manson River, not far from den
24/04/97	F09	At/PI	25	15:30	Next to Muscovite lakes, ~2km north of den site

Appendix 9.6.2 (cont.)

Date	ID	Habitat	Canopy Cover	Time	Comments
24/04/97	F16	Pi/Sw	40	12:28	Just up river from den site, in top edge of pine/spruce forest close to where it meets clearcut. Upslope from river, near draw/